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THE TELEGRAPHIC JOURNAL AND
Electrical Review.
Vol. XVI.—No. 392.

INCANDESCENT LAMP PATENTS.

It is somewhat curious to note the almost invariable tone of holy indignation and self-righteousness which prevails amongst parties to legal suits—for that matter amongst parties of any kind, but particularly, so far as we are at present concerned, where legal questions are subjects of dispute. To read the assertions of the Edison party alone in the coming litigation in America respecting incandescent electric lamps (which, by the way, bids fair to rival, if not exceed, in sensationalism the recent telephone litigation in the States), one could scarcely conceive the possibility of any successful opposition. There is such an air of confidence, such an appearance of mild contempt for the pretensions of the opposing party, and withal such an imposing array of facts, as one might suppose, in the shape of patents, all duly numbered and dated, that to disbelieve would seem to be wickedly or foolishly incredulous. But turn to the other side! There you find the same confidence as to the result of the suits, the same contempt for the claims of the opposition, and also a similarly imposing list of patents, numbered, dated, and guaranteed correct. The suing party in the first instance, as far as we can understand, is the Edison Electric Light Company, which has commenced action in the United States Circuit Court, at New York, against half-a-dozen other electric lighting companies for infringements of the Edison patents for incandescent electric lighting, also suing a number of representative users of the light supplied by the alleged infringers. A contemporary, which should be well informed, asserts that, inasmuch as the suits in these cases are for the determination of the absolute ownership of the right to control all the great essentials in incandescent electric lighting, their issue directly affects not less than $15,000,000 of invested capital. Mr. Tomlinson, solicitor of the Edison Electric Light Company, after stating Mr. Edison's claims, puts the whole case simply thus: "Grant him those—and both have been granted all over the world—and what is there left of the incandescent electric light, outside those essentials, for anybody else?" Ah! what indeed? Mr. Tomlinson does not say, but concludes with the remark, especially valuable coming from a solicitor, and, moreover, the solicitor of the Edison Company—"We are perfectly satisfied that the suits must result in giving the Edison Company a monopoly of incandescent lighting."

It really does seem rather late in the day to commence actions of this kind, seeing how many years now the various systems attacked have been in operation. Mr. Edward Johnson sees this and explains. "Mr. Edison," he says, "would not give any time or attention to litigation while he was still engaged in perfecting the commercial application of his system of general incandescent electric lighting from central stations. He had demonstrated its feasibility scientifically, but had yet to prove it economically, to put it into competition with gas. To that problem he has devoted himself with scarcely any intermission from October, 1878, until he deemed his system perfect in January last." Most interesting of all, however, will be the remarks of the redoubtable "Wizard of Menlo Park" himself. Mr. Edison says: "I do not claim to have been the discoverer of the possibility of a certain amount of illumination from an incandescent conductor of the electrical current, but I do claim—and can make good my claim—being the inventor of the only means for making the incandescent light practical. Before me, everybody who had experimented in that direction endeavoured to employ conductors of low resistance. I took exactly the opposite course, working with conductors of high resistance. When I had demonstrated that was the right way, they all suddenly discovered that that was just what they had been doing all along. At least they said so, which from their point of view was quite the same thing. Subdivision and high resistance are my discoveries, and the great principles upon which my patents are based. So original was all I did that I even had to coin words and applications of words—as, for instance, the specification, 'a filament of carbon'—since common in the literature of electricity, and used by my imitators in their applications for patents all the time, but unused before I employed them. Some of the patents upon which they base their claims are rather funny. The Swan patent is only upon the detail of making the carbon of parchment paper, which I tried, and which neither the Swan light people nor anybody else is using now. The Maxim patent, although the drawings make it look as if it was for a lamp, is only a method of exhausting the air from the globe of the lamp and filling the space with inert gas. The only durable and perfect way is that of a high vacuum in the globe, the attainment and preservation of which I have covered completely by patent. There is no question in my mind about the Courts sustaining the validity of my twenty fundamental patents, beyond which anybody is welcome to everything they can find in the way of details of application, that I have not already protected by the remaining 297 subsidiary patents."

The astonishing thing about all this is that there should be any opposition at all—that the defending parties should have the courage to contest the case. But they do, and here is what they say. The United States Electric Lighting Company, which holds the patent rights of Maxim, Farmer, and Weston, and which has instituted cross suits against the Edison companies, claims that "the incandescent light, *per se*, is old, and that Farmer some twenty-five years ago, so far as the distribution and regulation of the incandescent light is concerned, did what is done now in practice. He at that time lighted his house in Salem, Mass., with incandescent lamps, using substantially the same system of distribution and regulation as is used to-day. The United

States Company own various patents of Farmer's controlling these systems of distribution and regulation, and claim that every plant that the Edison people erect is an infringement of these patents." Then follow remarks as to Weston's priority in the region of dynamo-electric machinery, and the assertion that the Edison machines infringe Weston's patents. Then it is stated as a fact not generally known to the public that the first incandescent lamp which Edison claimed to have perfected, and which was heralded to the world as a solution of the problem of electric lighting, and for which he was granted a patent, was invented by Maxim; and that, after a bitter fight in the Patent Office, in which Maxim was victorious, though the Edison Company appealed the case until it reached the highest tribunal, Maxim was declared the original inventor, and the patent granted to him, thereby making Edison's patent void. This was the famous platinum lamp, the announcement of which caused such a heavy decline in gas stocks in England. It is claimed that the first commercial installation of an incandescent plant made in the States was by the United States Company in the Mercantile Safe Deposit Company's vaults, 120, Broadway, in 1880.

The outcome of these suits will be eagerly watched on this side of the Atlantic, and whatever may be the result, it may be taken as assured that litigation of a similar character will at once be pressed forward in the English Courts.

THEORETICAL AND EXPERIMENTAL RESEARCHES ON THE SECONDARY GENERATORS OF GAULARD AND GIBBS.

By PROFESSOR GALILEO FERRARIS.

(*Concluded from page* 460.)

SEC. 15.—*On the Power of the Secondary Generator.*

In the theoretical study with which we prefaced the description of the experiments we have seen how it is possible to calculate the energy which, for a given mean intensity of the primary current, a secondary generator may evolve either in its entire secondary circuit, or in the external part of the same. For this purpose we make use of the formula (38) which we transcribe

$$\frac{q'}{\frac{1}{2}\,\text{I}^2} = \frac{r'\,\text{C}^2}{r'^2 + \text{C}^2}, \quad \frac{q''}{\frac{1}{2}\,\text{I}^2} = \frac{(r' - \rho')\,\text{C}^2}{r'^2 + \text{C}^2} \qquad (38)$$

and in which formula $\frac{1}{2}\,\text{I}^2$ represents the mean of the squares of the intensity of the primary current, a mean which is read directly on the instruments of measurement employed for alternating currents; q' and q'' respectively represent the quantity of energy evolved in a second respectively in the total secondary circuit, and is its external portion.

The second clauses of (38) represent the resistances by which it is necessary to multiply the mean square of the intensity of the primary current in order to find the values of q' and of q''.

It is besides demonstrated that $\frac{q'}{\frac{1}{2}\,\text{I}^2}$ is at its maximum when $r' = \text{C}$, and that the value of the maximum is $\frac{\text{C}}{2}$, and that in like manner $\frac{q''}{\frac{1}{2}\,\text{I}^2}$ reaches its maximum for $r' = \rho' + \sqrt{\rho'^2 + \text{C}^2}$, and that its value will then be closely approximate to

$$\frac{\text{C}^2}{2\,(\text{C} + \rho')}$$

It may be interesting to see what are the values of $\frac{q'}{\frac{1}{2}\,\text{I}^2}$ and $\frac{q''}{\frac{1}{2}\,\text{I}^2}$ for the secondary generator upon which my experiments have been performed.

For this purpose it is sufficient to introduce into the formula (38), and into the expressions which we have thence deduced with respect to the conditions of the maximum the value

$$\text{C}^2 = 500, \ \text{C} = 22{\cdot}36.$$

We find then

$$\frac{q'}{\frac{1}{2}\,\text{I}^2} = \frac{500\ r'}{500 + r'^2}, \quad \frac{q''}{\frac{1}{2}\,\text{I}^2} = \frac{500\,(r' - 0{\cdot}28)}{500 + r'^2}. \qquad (38')$$

The maximum value of $\frac{q'}{\frac{1}{2}\,\text{I}^2}$ corresponds to

$$r' = \text{C} = 22{\cdot}36$$

and is $\frac{\text{C}}{2}$, therefore

11·18 ohms.

If there is given the mean intensity $\frac{\text{I}}{\sqrt{2}}$ of the primary current with the secondary generator, we can quickly calculate the maximum quantity of energy which the apparatus produces in the total secondary circuit by simply multiplying the square of the given intensity by the resistance 11·18. Supposing, for instance, that the apparatus is made to act by means of a primary current, the mean intensity of which, as found by an electrometer or a calorimeter, equals 12 ampères, it is found that the maximum quantity of energy which the secondary generator can give in the total secondary circuit, the maximum quantity given when the resistance of the secondary reaches 22·36 ohms, is

$$12^2 \times 11{\cdot}18,$$

therefore 1610 voltampères per second. This quantity of energy corresponds to $\frac{1610}{736}$ or to 2·19 horse-power.

The maximum value of $\frac{q''}{\frac{1}{2}\,\text{I}^2}$ corresponds to

$$r' = \text{C} + \rho' = 22{\cdot}36 + 0{\cdot}28,$$

therefore to

$$r' = 22{\cdot}64 \text{ ohms},$$

and is $\frac{500}{2 \times 22{\cdot}64}$, therefore

11·04 ohms.

If we then, as we have done a little earlier, suppose that the mean intensity of the primary current is 12 ampères, we find that the maximum quantity of energy evolved in the external part of the secondary circuit, that is the maximum utilisable theoretical energy is equal to

$$144 \times 11{\cdot}04,$$

that is to 1590 voltampères for 1″, that is again to

$$\frac{1590}{736} = 2{\cdot}15 \text{ horse-power.}$$

Such is the theoretical product of the apparatus; the effective yield of utilisable energy in the outer circuit is, according to the conclusions which we have arrived at experimentally, $2{\cdot}15 \times u$, that is, putting $u = 0{\cdot}99$, 2·12 horse-power.

When the apparatus yields this maximum quantity of utilisable energy in the outer secondary circuit there will be absorbed in working a quantity of energy equivalent to

$$\frac{2{\cdot}12}{\nu} \text{ horse-power.}$$

where (ν) represents the coefficient of external effective yield.

From the table given in Sec. 11 there is found for the coefficient, (ν), the value 0·95; it is therefore apparent that when the mean intensity of the primary current, as read off on the electrometer, is 12 ampères the maximum work which the apparatus can absorb is $\frac{2{\cdot}12}{0{\cdot}95}$, that is 2·23 horse-power.

When $r' = 22{\cdot}64$ ohms, and the apparatus produces the maximum utilisable energy the practical coefficient of yield differs by about 1 per cent. from the maximum reached for $r' = 31{\cdot}9$ ohms. As, therefore, in practical industrial applications, it is important to have good coefficients of yield, inasmuch as it is useful to obtain the maximum effects with small apparatus, it may be deduced from the foregoing results that probably the best mode of working in the practical applications of a secondary generator equal to that with which we have experimented consists in making it work with a resistance r' of the secondary circuit equal to 22 or 23 ohms.

Instead, in the trials of practical applications hitherto made by M. Gaulard the apparatus has been worked only with a secondary circuit of a resistance equal to 8 or 10 ohms. This is a consequence of the false interpretation of experiments which has led all experimentalists and inventors to the erroneous idea that the coefficient of yield of the apparatus was equal to $\frac{v'\,i'}{v\,i}$ that is to $\frac{r' - \rho'}{r'}\,m$, and that it would have its maximum value for a resistance of the secondary circuit comprised between 5 and 6 ohms.

For $r' = 10$ ohms the second formula (38′) gives

$$\frac{q''}{\frac{1}{2}\,I^2} = 8{\cdot}10 \text{ ohms.}$$

Whence for $\frac{I}{\sqrt{2}} = 12$ ampères it is

$$q'' = 1166 \text{ voltampères for } 1'',$$

which means that the apparatus gives in the outer part of the secondary circuit energy equivalent to $\frac{1166}{736}$ that is to 1·58 horse-power the coefficient of external effective yield (ν) for $r' = 10$, according to the table given in Sec. 11 is equal to 0·93, the energy absorbed in the apparatus is equal to $\frac{1{\cdot}58}{0{\cdot}93}$ that is to 1·70 horse-power.

The apparatus absorbs energy equivalent to 1·80 horse-power if it is actuated by a primary current of mean intensity equal to about 12·3 ampères. And, in fact, M. Gaulard habitually causes a secondary generator of the type experimented on to absorb the energy of about 1·80 horse-power by using a current which, roughly measured with a Siemens electro-dynamometer, gave a mean result slightly above 12 ampères.

Influence of the Structure of the Core upon the Power of the Apparatus.

I have had occasion to point out that the apparatus with which I executed my calorimetric experiments and that with which M. Uzel made his electrometrical experiments differed from each other simply in as far as the former had a core of wood covered with a layer of iron wire, whilst the other had a core consisting entirely of a bundle of iron wires. The latter was the construction originally adopted by M. Gaulard; the other is an innovation introduced by the inventor with the view of diminishing the Foucault currents, and thus improving the conditions of the secondary generator.

We have seen that the modification of the core has not improved the coefficient of yield, since the value of u, calculated from the calorimetric experiments made on the generator with the wooden core comes out exactly equal to that calculated from the experiments executed by M. Uzel on a generator with a core entirely of iron. But the power of the apparatus may have varied by reason of the modification of the core, that is, the quantity of energy which with a given intensity of the primary current the apparatus may absorb and give out in the secondary circuit. It is a question of practical importance to see if this has really been effected, and what is the variation.

To solve this question it is needful to determine the value of C for the secondary generator studied by M. Uzel, and unhappily, for reasons developed in Sec. 11, this cannot be done with satisfactory accuracy by means of the data from the experiments which are at hand.

Nevertheless, without pretending to make an exact determination, we can make the attempt to establish between the two apparatus a comparison sufficient to judge, from a practical point of view, of the suitableness of the modification introduced by the inventor in the construction of the core. We can make use of an approximate value of C obtained from the experiments cited.

From considerations which we have developed in Sec. 11 relative to the errors which may be committed in calculating C^2 by means of the formula (58), it results that such errors are so much the less as the resistance, r', with which we are experimenting is greater. We can determine with this formula with some security the value of C^2, making use of the results obtained with a greater resistance, r'. And as the table of the values of u, derived from the experiments of Uzel, shows that the two last experiments, in which the value of r' is greater, gave values of u exactly equal to the mean, we may retain as trustworthy a value of C drawn from the two said experiments.

The formula (58) may be written

$$C^2 = \frac{r'^2\,i^2}{u\,i^2 - i'^2}$$

or if we observe that $r'\,i' = v'$ $C^2 = \frac{v'^2}{u\,i'^2 - i'^2}$.

If we put for u its value 0·99 and substitute for v', for i and i' the values registered in M. Uzel's table of experiments (Sec. 6), we obtain the following results:

v'	i	i'	C
119	12·13	11·13	25·5
138	,,	10·95	27·2

We shall have an approximate value of C with a probable relative error of 5 per cent. by taking the mean of the two values 25·5 and 27·2 and putting:

$$C = 26{\cdot}3.$$

The substitution of the wooden core for one entirely of iron, has had for its effect a decrease of the value of C from about 26·3 to 22·36, that is to say, about 15 per cent.

The consequence of this decrease of C is that also the quantity of energy which the secondary generator can absorb and give out when it is actuated by a primary current of a given intensity, is diminished. For a generator with a core entirely of iron the maximum value of $\frac{q''}{\frac{1}{2}\,I^2}$ which, as we have found, is equal to $\frac{C^2}{2\,(C + \rho')}$ is $\frac{(26{\cdot}3)^2}{2 \times 26{\cdot}6}$, that is 13.

Therefore with a primary current of 12 ampères, the maximum theoretical work which the secondary generator can give in the outer secondary circuit is

$$\frac{144 \times 13}{736} \text{ horse-power.}$$

that is 2·54 horse-power.

The maximum effective work is then

$$0{\cdot}99 \times 2{\cdot}54 = 2{\cdot}51 \text{ horse-power.}$$

On the other hand, for a secondary with a core partially of wood, we have found 2·12 horse-power.

The decrease in the power of the apparatus is therefore equal to about 16 per cent. And as the coefficient of theoretical yield which diminishes with the decrease of C is also somewhat diminished when its relation to the coefficient of effective yield remains constant, we may conclude that *by this substitution of a core with wood for one entirely of iron, M. Gaulard has distinctly deteriorated his apparatus.*

It will not be useless to remark before concluding, that when the core is entirely of iron, the best means of using the secondary generator in practical operations is to make it act with a resistance r' of the secondary circuit equal to about 26·6 ohms.

ON UNIPOLAR MACHINES.

UNIPOLAR machines seem at first sight to possess considerable advantages as compared with the ordinary dynamos, in virtue of their simplicity and rational mode of action. No wonder that many electricians have been engaged with their construction. So little, however, has hitherto been made public concerning this interesting subject that I am led to study a machine of this kind, writes Herr Hummel in *Electrotechnische Zeitschrift*, more closely in order to decide whether or not they are capable of practical application.

The principles upon which the unipolar machine is based are very simple and come into play, also in the electro-dynamic and magneto-electric rotatory instruments of Jamin, Barlow, &c. Only there, by the action of the current, a conductor is set in motion in presence of a fixed conductor or magnet, whilst here, on the other hand, a current is produced inversely by the movement of a metallic conductor near a conductor traversed by the current, or a magnet. Instead of a fixed conductor a powerful electro-magnet is advantageously used, and a rotatory movement is given to the conductor to be moved.

In practice two positions of the moved rectilinear conductor come into consideration; one in which it lies parallel to the axis of the magnet and the other in which it intersects this axis at a right angle.

Instead of a single rectilinear conductor it is better, in the first case, to take a copper cylinder which partially incloses the magnet, and, the second case, a disc which revolves in front of the plate.

The first point is to decide which of the two arrangements is the most rational, and, further, what is the most convenient position and length of the moving conductor as regards the magnet, and what electric work can be developed in proportion to the size of the machine and the number of revolutions.

Without entering into preliminary experiments I must briefly mention that the cylinder arrangement is preferable, that, further, the length of the cylinder should be equal to the length of the electro-magnet, and that the maximum action is secured when the cylinder is pushed half over the magnet, so that half the magnet is inclosed in the cylinder. Before giving the construction of a machine founded upon this principle the experiments must be mentioned by which the theoretical yield of such can be predetermined simply and with the greatest certainty. Above all things, we must ascertain the tractive force which a single wire can exert in front of an electro-magnet. To this end the experiment was arranged as follows (see fig. 1).

A is an electro-magnet, b a stirrup in front of it, into which the current coming from the electro-magnet enters into a mercurial capsule and leaves it again through a.

The stirrup receives by the action of the current a tendency to revolve, but a weight, p, counterpoises the force by which it is deflected.

The weight, p, hangs on a fine wire, passing through a small hook fixed to the stirrup, and is secured to a sliding piece, c, which can be moved along a graduated rod, M.

It will be seen that the horizontal pressure exerted by means of the weight, p, can be modified at pleasure by moving the sliding piece, c. It is (fig. 1) when the angle of the connecting line, c, d, with the perpendicular, $o\ d$, is denoted by α

$$h = p \tan. \alpha = p \frac{o\ c}{o\ d}.$$

As $o\ d$, and also p, are constant the horizontal pressure of p, which is equal to the electrical, can be measured by the length, o, c.

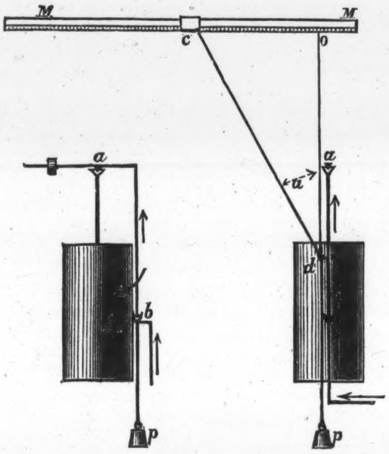

FIG. 1.

Notwithstanding its simplicity the apparatus was so sensitive that the stirrup was no longer in equilibrium on the slightest fluctuations of the current.

The tractive force which the stirrup can exert with different strengths of current was first determined in grammes.

The values obtained are given graphically in fig. 2, the strengths of the currents being plotted out as abscissæ and the horizontal pressures as ordinates.

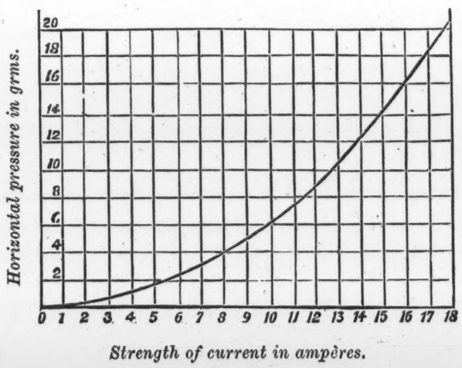

FIG. 2.

As might be expected, the character of the curve is parabolic. For the constants of the apparatus the pressure can be calculated by the equation:

$$D = c \times J^2.$$

From the results of this experiment we may calculate the electric yield which can be obtained from such a machine. If we call p the tangential pressure measured in grammes which the stirrup exerts for A ampères, n the number of revolutions which can be given to it, and r the vertical distance of the stirrup from the magnetic axis the mechanical performance in horse power is then:

$$\frac{A\,p \,.\, 2\,r\,\pi\,n}{60{\cdot}75} = \frac{A \,.\, V}{736},$$

when A denotes the number of ampères developed, and V the accompanying E.M.F. Losses of effect are here overlooked.

The above equation may also be written :

$$\text{V} = \frac{2 \cdot r \cdot 736}{60{\cdot}75} p \cdot n \cdot \pi = 0{\cdot}001025 \cdot p \cdot r \cdot n.$$

If we put $n = 1500$ and $r = 0{\cdot}09$ (dimensions corresponding to the experimental magnet) we have :

$$\text{V} = 0{\cdot}001025 \cdot 0{\cdot}09 \cdot 1500\, p = 0{\cdot}1385\, p.$$

The magnitude, p, depends on the dimensions of the magnet.

On the above suppositions 0·138 volt could be obtained with the electro-magnet employed if it was supplied with 15 ampères.

The strength of the current does not enter into the above equation. If we overlook the losses of effect by the heating of the stirrup, then, if W signifies the external resistance, the strength of the current is

$$\text{A} = \frac{\text{V}}{\text{W}}.$$

The internal resistance can be made so small that it may be justifiably neglected.

As the equation shows, with this machine there can be produced colossal currents, since it is merely needful to select W suitably in order to increase A at pleasure. According to the experiments above described, a machine was constructed in which the above mentioned magnet was used.

The drum was 290 millimetres in length, its diameter was 170 millimetres, and the thickness of the sheet metal was 3 millimetres.

Hence the resistance is calculated at 0·0000030 ohm. Fig. 3 shows the construction of the machine.

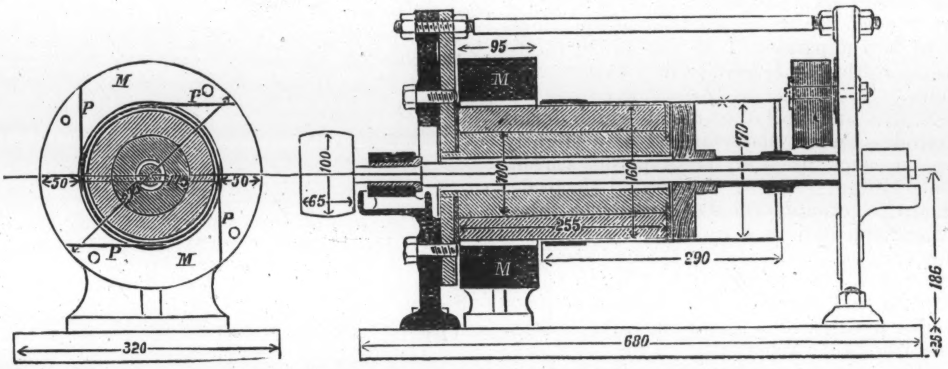

FIG. 3.

M is an iron armature to strengthen the magnetism.

The current is taken up at the axle and on the circumference of the open end of the drum by means of the four brushes, P, P, P, P ; it passes through the axle and the bearings, and in part through a brush, which is introduced to diminish the resistances of contact into the right side of the machine frame. Hence it passes through the external circuit to the massive cast metal piece, M, with which the brushes are in metallic connection.

The electromotive force of the machine was first determined at 1,220 revolutions, whilst the magnets were excited by different strengths of current. The following values were obtained :—

No.	E.M.F. open.	Exciting current in ampères.
1	0·105 volt	6·5 ampère
2	0·14 „	9·7 „
3	0·12 „	10·0 „
4	0·17 „	12·3 „
5	0·21 „	16·0 „

The E.M.F. obtained is therefore higher than that calculated from the experiments on account of the favourable action of the armatures appended to the electro-magnet.

The transverse section of the drum is about 1,500 square millimetres ; 2 ampères per square millimetre would be a still smaller demand, according to which the drum would be able, with an external resistance of $\frac{0{\cdot}21}{3{,}000} = 0{\cdot}000070$ ohm, to produce a current of 3,000 ampères.

In this respect the machine would be qualified to play a prominent part, especially in galvanoplastics, since, in addition to its simplicity of construction, it would have the great advantage of a very high electric useful effect, and of a rational mode of action. Unfortunately, however, there is in this machine a mechanical defect which can never be avoided, and which consists in the impossibility of taking up the current in a suitable manner. The outer margin of the drum can certainly be connected with the axle by a disc, and the current can be obtained from the former. The margin of the drum in the middle of the magnet requires the rubbing of several brushes over a very wide extent, and this must especially be made as large as possible, because the E.M.F. is proportional to it.

This friction on the one hand involves a great waste of power and a loss of copper by wear and tear, and on the other hand it entails such a considerable resistance, that by far the greater part of the E.M.F. is lost if the currents are at all strong. If, *e.g.*, the resistance is only 0·001 ohm, this at 200 ampères would involve a loss of potential of 0·2 volt.

The following experiments give sufficient explanation on this subject.

A copper wire of 10 millimetres thickness and 470 millimetres in length was extended between the terminals and the E.M.F. was measured upon it.

The results were as follows :—

No.	Exciting current.	E.M.F. at terminals.	Exterior resistance.	J.	J.A.	Number of revolutions.
	ampères.	volts.	ohms.			
1	7	0·04	0·00015	266	10·7	1210
2	9·8	0·05	—	333	16·6	1220
3	10·4	0·055	—	366	20·3	
4	11·7	0·065	—	434	28·1	
5	14·0	0·08	—	533	42·7	
6	16·4	0·09	—	600	54·0	

From experiment No. 2 of the former, and of the present table, the resistances may be calculated.

The loss of potential in the same, amounts in round numbers to 0·1 volt for 333 ampère, which represents a resistance of $\frac{0{\cdot}1}{333} = 0{\cdot}0003$ ohm.

A diminution of the resistances to such an ex tent as a rational working of the machine would require seems, therefore, excluded from the very first. We may feel tempted to try other arrangements, but on careful consideration we find that there is little prospect of effecting any essential improvement.

It would lead us too far to reproduce here the totality of the possible combinations. The object of the above lines is merely to give a proof that the solution of the problem of the unipolar machine is theoretically correct in this manner only, but that practical trials overturn all our high expectations of an industrial utilisation of this interesting machine.

ON A NEW BATTERY, CALLED THE AUTO-ACCUMULATOR.[*]

By M. JABLOCHKOFF.

HAVING been for a long time occupied in searching for a simple and inexpensive voltaic battery, I first constructed one of which the combustible metal, which was sodium, was directly attacked by the oxygen of the atmosphere. This apparatus possessed advantages, but it had the defect that it was impossible to suspend its action unless by removing it from contact with the air.

I attempted at first to obviate this inconvenience by joining to the battery an accumulator for collecting the work, but as this combination necessitated the simultaneous use of two apparatus, I succeeded in eliminating this complication by forming a new battery with three electrodes.

It comprises first an oxidisable metal which forms the first electrode; then a plate formed of a slightly oxidisable metal, such as lead, or of porous carbon capable of polarisation, forming the second electrode, and lastly, another electrode formed of lamellæ or tubes of very porous carbon immersed in air.

Among the various types employed I will describe only the most recent. It is composed of a flat vat of lead, or lined with lead, in which are placed fragments of the oxidisable metal, which may be sodium, sodium amalgam, zinc, iron, &c. When this metal is placed, the vat is filled up to its edge with any spongy matter, packing cloth, wood sawdust, &c.

Two cases may then occur: if we use sodium it is not necessary to introduce water, as the sodium becomes oxidised, forming caustic soda which attracts moisture; if the metal employed is zinc or iron, the spongy mass is moistened with a solution containing either common salt or, preferably, chloride of calcium, which attracts and retains moisture.

Lastly, upon the levelled spongy mass is placed a range of tubes of porous carbon. For this grouping I prefer to substitute for the leaden vat one of paraffined carbon.

The action set up in this battery is as follows: when the element is formed but remains open there are established local currents between the oxidisable metal and the electrode upon which it is placed. This latter is polarised and its potential rises until it has reached that of the metal; the action is then arrested or reduced to a minimum. If we wish to collect the exterior useful current it is sufficient to connect by a conductor the electrode thus polarised to the other electrode of carbon; the discharge begins; the local currents resume their action and restore to the electrode its charge in proportion as it is expended.

The elements of this battery have been determined on several occasions and found as follows: the electromotive force depends on the oxidisable metal employed; with sodium amalgam it is 2·2 volts; with zinc 1·6 volt; with iron 1·1 volt.

The internal resistance of an element measuring 0·1 metre on its side varies between 0·25 ohm and 0·50 ohm, according to the thickness of the spongy layer and its degree of moisture.

The external dimensions are 0·1 metre in square by 0·025 metre in height; the weight is from 200 to 250 grms.

The advantages of this battery are its simplicity and convenience of manipulation. It is managed in this manner: the elements are ranged in batteries of a regular form and connected in groups of ten at most. The battery may be charged with oxidisable metals for several months, and it is merely necessary to renew the liquid from time to time. For that purpose we take a group of elements, steep it in pure water, withdraw it, let it drain and then steep it in a trough filled with a solution of chloride of calcium. This is taken up by the spongy body, the excess is poured away and the battery returned to its place.

This simple operation needs only be performed very rarely if the battery is used for such work as bells, telegraphing, &c. If the current is employed for light or for mechanical power, the liquid must be renewed every 24 or 48 hours.

We may remark that this battery works only when its current is utilised, and that it gives off no odour.

It utilises the local currents which are so injurious in ordinary batteries, and above all,

It yields electric energy very cheaply, as the metals are employed in the state of waste, filings, turnings, &c.

If we suppose that iron is used, it is known that to obtain one horse-power for an hour 850 grms. of metal must be consumed. But iron turnings are worth 0·05 franc per kilo, or for this quantity 0·04 franc. As for the chloride of calcium it has no value.

We may therefore affirm that this battery gives the energy of one horse-power hourly for an outlay of 0·05 franc.

JOLIN'S IMPROVEMENTS IN ELECTRIC BELLS.

THESE improvements, designed by Mr. P. Jolin, consist in arranging a system of electric bells in such a way, and with such modifications of construction, as will enable a number of trembling bells to be worked in series in one simple circuit. This has hitherto been impracticable with trembling bells, because as hitherto constructed such bells work by breaking the circuit during their vibrations.

Instead of winding the coils or bobbins of the electro-magnets of the bells, as is commonly the practice, with one wire only, and using a contact maker and breaker, to interrupt the current and thus magnetise and demagnetise the electro-magnet, Mr. Jolin has the coils or bobbins of the electro-magnet wound with a double or divided coil, so arranged and connected that the electric current in traversing the two parts, branches, or divisions of the coil, produces no magnetising effect until the current in one part, branch, or division of the coil is diminished or stopped by the opening or rupture of that part, branch, or division.

In ordinary electric bell electro-magnets the magnetisation of the iron cores is excited when the current is made at the contact maker and breaker, and ceases or is discharged when the current is broken, and in consequence at the breaking of the circuit there is a self-induced or extra current spark due to the discharge of the magnetisation of the core or cores. In the improved method of winding with two opposing sets of coils, when both branches or windings of the circuit are closed the core or cores remain unmagnetised; on breaking the circuit of either branch the whole current is thrown round the other branch of the circuit, and the core is magnetised without any spark of self-induction occurring. When the circuit is again made through this branch, the magnetisation is discharged from the iron core, because the current now circulates in two opposing senses in the two branches, but there is again no spark, for the circuit is closed before the discharge current or extra current of self-induction is set up.

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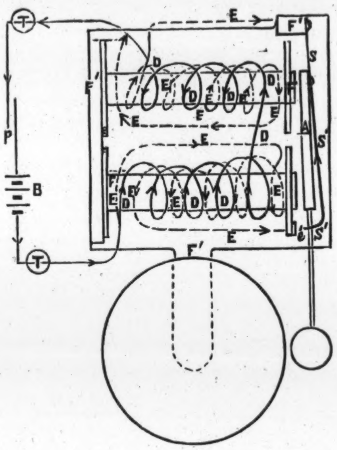
[*] *Comptes Rendus.*

The fig. shows an ordinary trembling electric bell, wound according to the new method. E, E, E, E, is one part branch or division of the circuit, in these cases the one that is opened and closed or broken and made, and D, D, D, D, the other part, branch, or division of the circuit, which is always closed in the bell. T, T^1, are the two terminals. F^1 is a frame carrying the core or cores, F, and the spring, S, which in turn carries the armature, A; this spring is prolonged to, S^1, S^1, below or at the side of the armature, so that when the said armature is attracted it touches or rests upon the contact piece, e^1, but when the armature is at its normal position, S^1 is clear of e^1. The circuits are connected so that one end of the part, branch, or division, D, D, D, D, is attached to the terminal, T, and the other end to the terminal, T^1, that part, branch, or division being closed in the bell, one end of E, E, E, E, is connected to T, and the other end to e^1 in single core electro-magnet bells, a connection from the frame, F^1, armature, A, and spring, S, being made to the terminal, T^1; but when two electro-magnets cores are used, the connections of E, E, E, E, are usually made as follows: one end of E of one core is connected to the terminal, T, the other end being connected to e^1, an end of E of the other core is connected to the frame, F^1, armature, A, and spring, S, and the other end of E on this last core is connected to the terminal, T^1. The circuits being so arranged and connected that when the spring, S^1, S^1, touches e^1, the current flows through D, D, D, D, and E, E, E, E, in opposite directions, thereby the current in one part, branch, or division, neutralises the effect of the current in the other part, branch, or division.



The action is as follows:—When the armature, A, is held from the core or cores, F, by the spring, S, the core or cores are magnetised by the current flowing in D, D, D, D (the circuit outside the bell through the battery, B, being completed by closing the push, P), and the armature, A, is attracted, but on the spring, S^1, S^1, touching e^1, the circuit in E, E, E, E, is completed, the magnetisation of the core or cores destroyed, and the armature released without any sparking.

THE REGULATION OF THE SPEED OF ELECTRO-MOTORS.

By M. MARCEL DEPREZ.

THE considerations laid down in my former note (*Comptes Rendus*, April 27th, 1885, p. 1128) render it possible to determine the direction and the magnitude of the variations in intensity which the magnetic field of a magneto-electric machine must experience, serving as a recipient when the resisting couple applied to it happens to vary, and it is still desired to keep its speed of rotation constant, the difference of potential at the extremities of the machine being rendered invariable by any procedure whatever. Let us call ε the difference of potential at the extremities of the machine; i the intensity of the current which traverses the first coil of the conductor; i' the intensity of the current traversing the second coil of the conductor; n the number of spirals of the first coil; n' the number of spirals of the second coil; r the resistance of the first coil; r' the sum of the resistances of the second coil and of the ring; E the counter-electromotive force developed by the rotation of the ring; ν the speed of the ring expressed in revolutions per second.

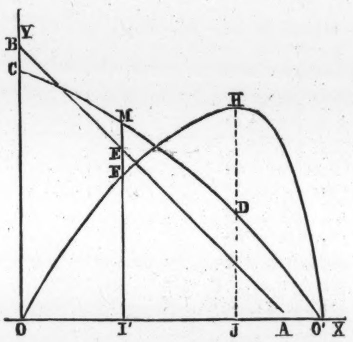
The intensity, i, of the current traversing the first coil has the value

$$i = \frac{\varepsilon}{r};$$

and the intensity of the current traversing the ring, and the second coil is given by the equation

$$i' = \frac{\varepsilon - E}{r'}.$$

In this second equation the counter-electromotive force, E, of the ring is proportional to the speed, ν, of the ring and to the intensity of the magnetic field. But the intensity of the magnetic field produced by a coil of n spirals traversed by a current, i, is a function of the product, $n\,i$; if a second coil of n' spirals, traversed by a current, i', acts simultaneously with the former upon the iron core of the inductor, and if the two coils are linked mutually in such a manner as to occupy, so to speak, the same position with reference to the iron core (which is easily effected by composing them of sections belonging alternately to each coil), the intensity of the field will be a function of $n\,i + n'\,i'$. If the currents act in the opposite direction, as we have seen above, we must adopt the sign —. The binomial expression, $n\,i - n'\,i'$, may be written



$$n'\left(\frac{n}{n'}\,i - i'\right),$$

or if we substitute for i its value, and put

$$\frac{n\,\varepsilon}{n'\,r} = i_0,$$

$$n'\,(i_0 - i').$$

The magnetic field is therefore the same as that which would be produced by a coil of n' spirals traversed by current of which the intensity would be

$$i_0 - i'.$$

Let us now take two rectangular axes, O X, O Y. Let us plot out on the axis of the x the intensity of the current, i', which traverses the ring and the second coil, and on the axis of the y the counter electromotive force, e, corresponding developed by this ring when $\nu = 1$. Let us take O O' $= i_0$, setting out from O'; let us plot out from the right to the left the values of $i_0 - i'$, causing i' to increase from zero to i_0; the curve, O' D M C, which we obtain is no other than a characteristic, the concavity of which is turned towards the negative x instead of being turned towards the positive x as it takes place habitually.

Let us now propose to find the velocity which this machine takes when its extremities are placed in communication with a source of electricity which keeps them at a constant difference of potential, and that we apply to the ring a given resisting couple. The mechanical work expressed in watts developed by the ring in a unit of time is equal to $E\,i'$, or, remembering that $E = \nu\, e$, $\nu\, e\, i'$ the work per revolution is expressed by $e\, i'$, that is to say the product of the abscissa O I′ by the ordinate I′ M of the characteristic. Let us construct a new curve, O F H O′, which we will call the curve of momenta, having for its abscissæ the different values of i', and for its ordinates lengths proportional to O I′ × I′ M or $e\, i'$. It is easy to see that this curve cuts the axis of the x at the outset and at O′. When the characteristic, O′ D M C is a right line the curve of momenta is a parabola, the apex, H, of which has, as its abscissa, $\frac{O\,O'}{2}$.

Let us return to the equation $i' = \frac{\varepsilon - E}{r'}$; it gives $E = \varepsilon - r'\, i'$. If we plot out the values of E upon the axis of the y, and those of i' upon the axis of the x, we obtain the right line which cuts the axis of the x at a distance of $O = \frac{\varepsilon}{r'}$, and the axis of the y at the point B which has, as its ordinate, $E = \varepsilon$.

The characteristic, O′ D M C, the curve of momenta, O F H O′, and the right line, A B, will enable us to find the speed which the machine will take. If the resisting couple is represented by F I′ the intensity O I′ is at once given by the curve of momenta. But to this intensity there corresponds an electromotive force, I′ E, which is given by the equation $E = \varepsilon - r\, i'$, which is geometrically represented by the right line, A B.

But, on the other hand, this same electromotive force if deduced from the characteristic would have the value $I'\,M = e$.

The relation $E = \nu\, e$ gives $\nu = \frac{E}{e}$. *The velocity sought for is therefore given by the ratio of* I′ E *to* I′ M.

To render the speed constant we must be able to render this ratio constant. This is strictly possible only if the characteristic is a right line and if the right line A B passes by O′, which leads to the equation of condition $\frac{\varepsilon}{r'} = \frac{n\,\varepsilon}{n'\,r'}$, whence $n\, r' = n'\, r$.

If this condition were fulfilled there would result a curious consequence, *i.e.*, the machine when once brought to a stand-still must remain in that condition because the magnetic field would be always null whatever the intensity of the current. If, instead of seeking to render the velocity of the machine absolutely constant, which is impossible, we fix upon a superior and an inferior limit which are allowable the same construction permits us to solve the question with great ease.

Lastly, if we suppose the speed of the system established, and the resisting couple very small, we may cause it to increase from zero to J H; the intensity will increase from zero to O J, and the movement will be steady. But if we exceed the charge, J H, the equilibrium becomes unstable and the machine stops entirely, even if we lower the value of the resisting couple below J H when we perceive a diminution of speed.

This method also enables us to solve a number of other questions, into the details of which I cannot enter.

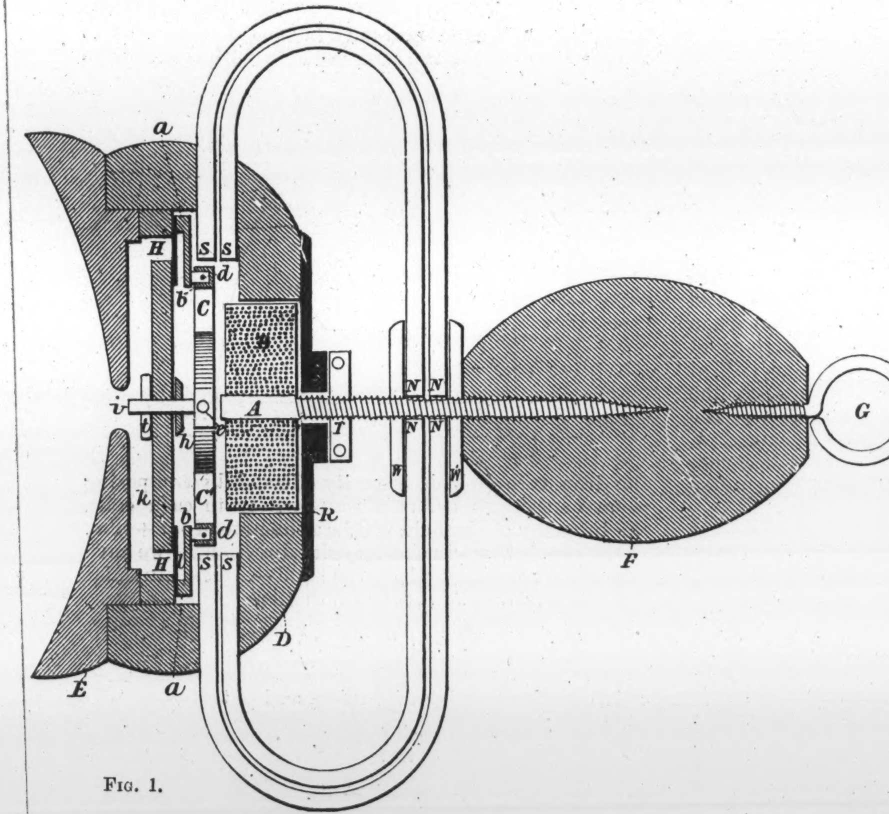


FIG. 1.

FIG. 2.

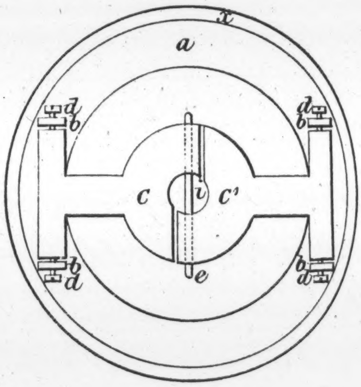
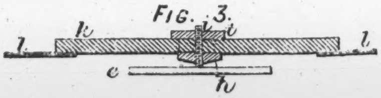


FIG. 3.



THE "BASSANO-SLATER" IMPROVED TELEPHONE.

THE accompanying sketches show an improved form of telephone receiver recently patented by Messrs. G. H. Bassano, A. E. Slater, and F. T. Hollins, of Derby, the two former carrying on business as telegraph instrument manufacturers at Derby. The inventors have been so good as to place at our disposal a receiver constructed according to their patent, and we find that it gives excellent results, being both sufficiently loud and very distinct in its articulation; it is, in fact, a good practical instrument. The very many patents taken out for telephone receivers are, as a rule, conspicuous only for their want of novelty. So far as we are able to judge, this receiver has several points in which it differs from others, and is generally a novel and, we understand, most effective arrangement, but it being *sub judice*, we express no opinion as to its bearing on existing patents. Fig. 1 is a section of the complete receiver; fig. 2 a plan of an improved arrangement of bar armature; and fig. 3 a section of a steel wire T-piece, carrying a disc of pine, or other non-inductive material. Corresponding parts are indicated by the same letters. Now in fig. 2 *a* is a brass rim having an outer ridge or collar, *x*, and four small ears or lugs, *b*, *b*, *b*, *b*. C, C¹, are two soft iron bar armatures fixed on centre screws, *d*, *d*, *d*, *d*. These two bar armatures are kept in a state of tension by means of a small piece of thin steel wire, *e*, passing through a hole in the centre of the two armatures and riveted, or otherwise secured, only just at the ends of the wire, so that the greater part of the wire, even where passing through the armatures, is free to twist or untwist, as will afterwards be explained. To the centre of this small piece of wire is brazed a steel or iron pin, *i*, with a screw thread forming together a T-piece, shown in section fig. 3. The pin, *i*, carries a small brass washer, *h*, upon which rests a circular disc, *k*, of pine, or other non-inductive material, to the outer edge of which is glued a circular rim, *l*, of thin leather, macintosh, or other air-tight material, the disc being held at its centre by a small brass nut, *t*. Taking the arrangement of fig. 2, if a magnet is caused to approach the centre of the bar armatures, C, C¹, they are pulled out of their normal position, and, being centred at opposite points, and each firmly gripping the small piece of steel wire, *e*, which is squared just at its two ends, give the said wire a slight twist in opposite directions. If the magnet is now withdrawn the wire untwists, and throws the armatures sharply back into their normal position. Now as the wire, *e*, carries the pin, *i*, and the disc of pine by its centre, *k*, it follows that the latter, every time the armatures move, will also make a bodily movement backwards or forwards according as the bar armatures are attracted or released by the magnet. When, therefore, it is enclosed in a recess or air chamber, as in fig. 1, a condensation and rarefaction of the air takes place in the recess formed by the cap, E, corresponding to the condensations and rarefactions of the air operating the electric current at the transmitter, and which alter or reverse the magnetism in the magnet of the receiver. It is obvious, say the inventors, that the effect all depends upon the torsion of the small piece of wire, *e*, of thin hardened steel, the pitch and loudness of the sound depending upon the velocity and amplitude of the vibration of the disc, *k*. The inventors have therefore taken four U-shaped steel magnets, and placing their four similar or north poles, N, N, N, N, between the two soft iron rings, W, W′ (tapped to fit the thread on A), to polarise the soft iron screw, A; and the four south poles, S, S, S, S, to magnetise the two bar armatures, C, C¹, by magnetic induction. It is clear that a most intense magnetic field will be set up just at the end of the pole piece, A, and which causes the movement of the armatures to be extremely sharp when the magnetic field is altered by the electric current. The object of the thin ring of leather, *l* (which is fixed loosely so as not to impede the movement of the disc, *k*), is to make the movements of the pine disc air-tight. It is not, however, essential, but improves the efficiency of the instrument. A brass ring, H, clamps the thin leather, and it is in its turn secured by the screwed cap, E.

The inventors hold that this receiver is not an infringement of the Bell receiver, not having a plate of iron or steel, but bar armatures, and the disc of wood vibrating not as a tympan, but as a free vibrator, more approximating to the wood tongue of Reis than to Bell's steel tympan. The other parts will be understood; the nut, T, is for the purpose of regulating the distance between the pole piece and the armatures by springing the magnets open.

Cables to Japan.—The *Times* announces that it has been arranged to lay an English telegraph cable to Nagasaki.

ON CHARGING SECONDARY BATTERIES.*

By WILLIAM HENRY PREECE, F.R.S.

1. I HAVE for the past twelve months been experimenting with secondary batteries with a view of getting an efficient, uniform, and constant source of currents for lighting my house, and I have succeeded beyond my expectations. Some new facts have developed themselves during my experience, which I have thought of sufficient importance to bring before the Society.

2. The cells are of the Planté type, manufactured by the Elwell-Parker Company of Wolverhampton. Fourteen plates of plain sheet lead 17″ × 11″ are suspended in well insulated wood boxes filled with diluted sulphuric acid in the proportion of about 1 to 10. These plates are grouped in two groups of seven, each group being soldered to a lead strip, forming alternately the positive and negative poles of the cell. The plates of the respective poles are prevented from touching each other by ebonite grids or separators.† Each plate offers a surface of 1·3 square feet, so that the total surface of lead of each group opposed to each other is 9·1 square feet; that is, 9·1 square feet of peroxidised lead is opposed to 9·1 square feet of spongy lead. I use 24 such cells.

3. My charging current varies from 3 to 3½ ampères per square foot, while the current of discharge used in lighting my house varies from 1 to 1½ ampère per square foot. The total weight of each cell is 120 lbs. The plates are prepared by the Parker-Planté process before insertion in the cell, those forming the positive pole being well peroxidised, while those forming the negative pole are well coated with spongy lead.‡ They are thus, when put together, prepared at once to be charged. If they are not at once charged, local action sets in, and lead sulphate is injuriously formed.

4. I have cut away a small portion of the centre of the central plate of each cell to admit a hydrometer having a scale graduated from 1·050 to 1·150. The changes of the density of the liquid and of the colour of the plates give the fullest and clearest indications of the behaviour of the cell. The condition of the surface of the peroxidised plate as felt by the finger is also good evidence of its condition. If a plate is yellowish-brown and rough, it probably makes bad contact with the lead terminal; if black and hard, it wants the density of current regulated; if plum-coloured and greasy to the touch, it is in good order, and working well.

5. At the present time I am charging my battery twice a week, putting in at each charge about 120 ampère-hours; the battery is charged in two sections. During each charge observations are made every hour, and sometimes every half-hour (1) of the strength of current flowing through; (2) of the electromotive force; and (3) of the density of one or more of the cells. The relation of these three quantities tells me the condition of the charge. The following diagrams are typical cases:—

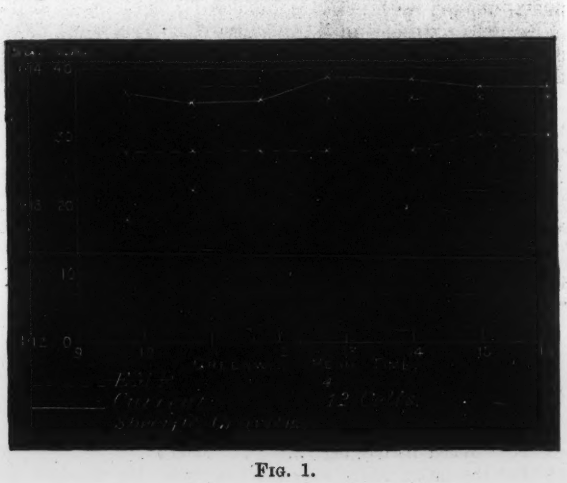


FIG. 1.

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* Paper read before Royal Society, May, 1885.

† These ebonite girds were introduced by Mr. Charles Moseley, and have effectually removed one incessant source of trouble in these cells, viz., short-circuiting through the buckling of the plates.

‡ The Parker-Planté process consists in immersing for a few hours the lead plates in a solution of nitric and sulphuric acids in these proportions:—

Nitric acid	1
Sulphuric acid	2
Water	17

before fixing in the cells. This not only chemically cleans the lead surfaces, but it favours the formation of sulphate of lead in such a way as to be readily converted into lead peroxide and spongy lead on the passage of a strong current through the cells. The formation of the cells is thus greatly expedited.

Take No. 4, which is the diagram of this morning's (April 28) charge of 15 cells. The following are the particulars :—

	E.	C.	D.
9.0 A.M.	37·7	32·24	1·115
10.0 "	40·2	32·24	1·119
11.0 "	42·5	31·50	1·121
12.0 noon	42·5	30·74	1·123
1.0 P.M.	42·5	29·95	1·124
2.0 "	42·5	29·95	1·124

6. It is evident that after four hours' continuous charging the battery was full, for the density, the electromotive force, and the strength of current became constant. The same scale of ordinates is used for volts and amperes. When each magnitude reaches its constant bubbles of gas are freely given forth, and energy is being wasted. The variation of the electromotive force and current strength is clearly due to the counter-electromotive force of the cells, which becomes a maximum only when the plates are fully formed. The counter-electromotive force partakes of the character of a higher resistance opposing the charging current, and increasing the proportion of the current through the shunt of the dynamo. Hence the changes of electromotive force are more marked than those of the current. Indeed, the changes in the electromotive force, as given by the voltmeter, are sufficient alone to indicate the progress and completion of the charge. They are more reliable than the evolution of gas. (My dynamo is shunt-wound, my voltmeter is Cardew's, a most reliable, simple, and valuable instrument, and my current meter a Siemens electro-dynamometer.)

7. I was at first much troubled with electrical leakage. The current escaped over the edges of the box trough creeping, and the formation of moisture from the spray of the solution when bubbles of gas arose in the liquid and burst on the surface. This was quite cured by standing each box on three white porcelain supports of the form shown in the following figure, the cups being half filled with resin oil on Messrs. Johnson and Phillips' plan. It is now quite impossible to measure the leakage except with a delicate galvanometer, and the insulation may be said to be practically perfect.

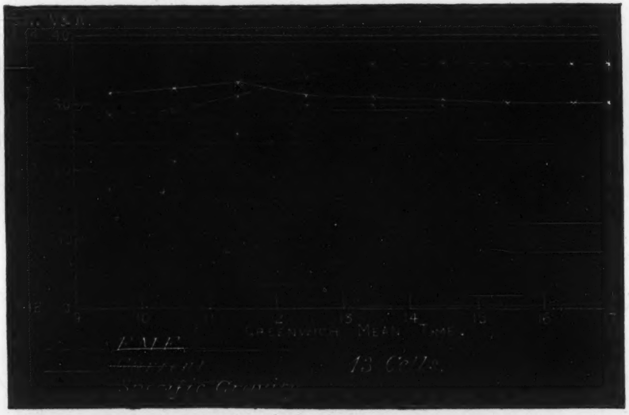

FIG. 2.

8. The E.M.F. of the battery at its terminals :—

When charging	2·25 per cell.
When idle	2·05 "
When discharging	1·90 "

The internal resistance is, per cell :—

When charging	·0060ω
When discharging	.0017ω

9. But the latter varies very markedly with the strength of current of discharge. This is shown by the following experiment made with 23 cells of a smaller type than those described above, which are used in the Post Office.

Current of discharge in amperes.	Internal resistance in ohms.
4·39	0·7608
7·25	0·4607
15·84	0.2816
25·07	0·1969

10. Thinking that this remarkable diminution of internal resistance might be due to the evolution of heat, I measured the temperature with a delicate thermometer.

Normal temperature of cell 12½° C. Current of discharge :—

5 ampères ...	No alteration of temperature perceived.
10 " ...	An exceedingly slight change.
16 " ...	About 12¾°.
20 " ...	Barely 13°.

The current in each case was kept on for twenty minutes, hence the diminution is not due to heat. Since the internal resistance varies in this way, I now always take the internal resistance with the same current, viz., 10 ampères.

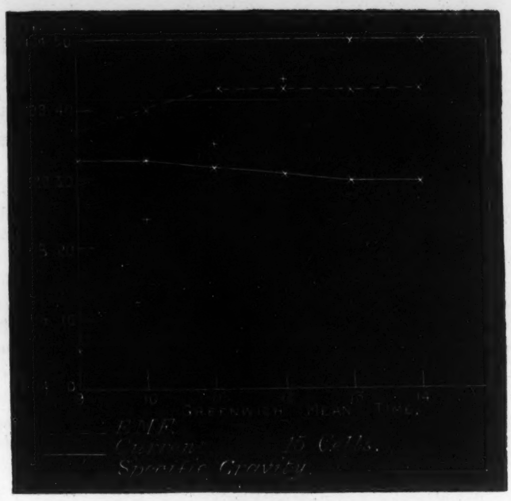

FIG. 4.

11. The capacity of these batteries certainly improves with age, and up to the present time I have seen no sign of decay or deterioration. M. Planté informed me that, though in course of time the peroxidised plate becomes very brittle, it is impossible to peroxidise it completely through ; there always remains a metallic core to give it strength. I find that this is so. Up to the present moment I have made no careful measurements of the efficiency of my battery. I cannot do so without deranging the lighting of my house, and I regard observations on single cells as illusory. I put in about 240, and I take out about 200 ampère hours weekly, and I do not observe any change or fall in the electromotive force. When the electromotive force of these cells falls, it falls rapidly, indeed, almost suddenly. Occasionally one plate of a group becomes inactive from undue local action, or from bad connection (shown by the colour). I remove this cell and put it in what I call a "hospital" cell, where it is brought into order either by a greater density of current or by reversal.

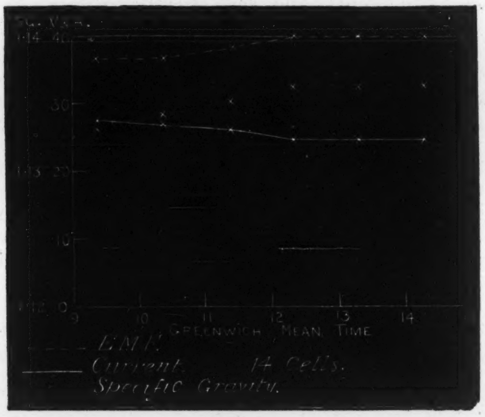

FIG. 3.

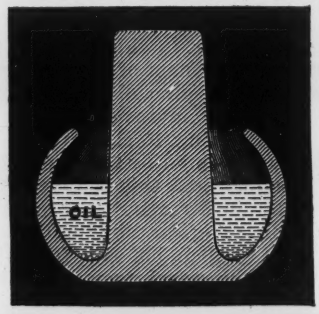

FIG. 5.

12. Reversing has a great beneficial action on a cell; it not only improves its capacity, but it removes any cause of irregular working. It is advisable to do this periodically. I have two extra cells, which enables me to have two cells always under reversal by means of the charging current. It takes from 1,000 to 1,200 ampère hours to reverse a cell, so that at this time of year it takes a month or more to complete the operation, and it will take a year to reverse the whole battery. I have thus, up to the present time, reversed 16 cells.

TELEGRAPH ACTS AMENDMENT BILL.

ON the order for the second reading of this Bill on Friday last week, Mr. Alderman Lawrence, who had an amendment on the paper, said what he wished was that the addresses of sender and receiver should be charged a fixed sum of 3d., that five words should be another 3d., that five words more should be 3d. more, making 9d., and that the charge of 1s. for twenty words should remain as at present. In the hope that the Government would further consider the matter during the short recess, he would refrain from moving his amendment at present.

Mr. PULESTON said if the sender were given a pecuniary interest in the curtailment of the address, the insufficiency of addresses would occasion much greater trouble and cost to the Post Office than it would lose from free addresses. The public would be exposed to the risks of miscarriage. But they ought not to consider too minutely the loss or gain in one branch of the business of a great department like the Post Office. He did not wish to oppose the Bill, but he hoped that the Postmaster-General would see his way to considerably modify the present proposals. For some time past he had taken a note of the number of words in the address of every telegram that he had received or sent out, and he had been unable to arrive at the average given by the right hon. gentleman. If the measure passed in its present form it would diminish rather than increase the business of the Telegraph Department, and instead of conferring a boon upon the public would absolutely prevent the development of the telegraph system.

DR. CAMERON said that, with regard to the reduction of telegraph charges, it was only fair to say that when his resolution had been proposed Mr. Fawcett had already explained his proposal for halfpenny a word telegrams with a *minimum* charge of 6d., if the Treasury would consent. In moving his resolution he had not pretended to dictate as to how the Post Office should proceed, but had laid down his resolution in the most general terms. Three schemes had been suggested; one of a halfpenny a word telegram, which Mr. Fawcett had said would involve an immediate loss of £160,000 or £170,000 for twelve months; the second, that of allowing the address of the receiver to be sent free, with a reduced number of words in the body of the telegram. That scheme it was calculated would involve a much larger loss for a longer time. The third scheme had been that of sending both addresses free at a *minimum* charge of 6d. for the telegram, which would have involved a still greater loss. Under the system now proposed by the Postmaster-General, he believed that on the average the public would have a great and substantial gain as compared with the existing arrangements. It should be remembered that telegraphy was not a necessary of life; and there was no good reason why the community at large should be taxed in order that the poor man should obtain a telegram below cost price. Moreover, as a matter of fact, the poor man made very little use of the telegraph. He intended to support the scheme of the Government as the best and most substantial boon the public were likely to get at the present time. On the question of figures, why, he asked, not adopt the system followed in international messages and count groups of five figures and less than five figures as a single word? To adopt such a course would be in the direction of assimilating the inland and the international departments of the postal telegraph service. Another improvement he wished to suggest was that in large towns the Post Office should codify the streets. Another improvement he suggested was the cheap registration of addresses.

Mr. SHAW-LEFEVRE said when in committee he should be happy to consider fully any amendments that might be brought forward, provided they did not involve a greater burden on the Telegraph Department than the plan laid down in the Bill. The telegraph service was not now in so flourishing a condition as it was two years ago. Owing to the increase of remuneration paid to *employés*, and also to the competition with the telephone, there had been a great reduction in the profits of the telegraph service. They had fallen from £450,000 to, at the outside, £250,000 a year, and out of this £250,000 there remained to be paid the interest on the £11,000,000 which was paid for the purchase of the telegraphs, and this reduced the interest to a very low rate. The plan that he now proposed had been carefully worked out by experts in the Post Office, and it was calculated that, allowing for an increase of 30 per cent. in the number of messages sent, there would during the first year be a reduction of the Telegraph Department profits by about £180,000, and this would reduce the profits to £70,000 a year, which was a very small margin of profit on a business of such magnitude. The reduction of the price of telegrams from 1s. to 6d. really involved a much larger financial risk than most persons supposed. A large number of telegrams had been carefully examined, and it was found that the number of superfluous words amounted to about 25 or 30 per cent., and a large proportion of the superfluous words occurred, it was found, in the addresses. These, on an average, now consisted of eleven words, and it was the opinion of competent persons that the address as a rule need not occupy more than five words. A saving of six words could thus be effected in each telegram, which was estimated to amount in the year to about £200,000. The tariff proposed by the hon. member for the City of London (Mr. Alderman Lawrence), that a free address and five words should be allowed for 6d., would result, as far as he could make out, although it was somewhat difficult to state the actual cost, in a loss of £100,000 a year more than his proposal. He thought, therefore, that the House would be of opinion with him that these various suggestions were all out of the question without inflicting heavy loss upon the department, and, therefore, upon the public revenue. The objections which had been raised to his proposal rested mainly on two points. In the first place it was said that the abolition of free addresses would lead to uncertainty and to extra labour on the department; and, secondly, it was said that it would be a hardship on certain classes of persons. As to the first point, the officials in the department did not think that any extra difficulty would be thrown on them, judging by the large experience they had had of foreign telegrams, and also to the fact that although the addresses in those telegrams were shortened little confusion or trouble had resulted. There was also the experience of foreign countries to guide them, where a word-rate prevailed. In Germany there was no free address, and it was found that addresses averaged only four words; again, in France a word-rate only existed, and no difficulty was found with respect to the address. The department believed that a very large proportion of the messages sent—about 30 or 40 per cent.—would be at the sixpenny rate; but they also thought that a very large proportion would be sent the cost of which would be between sixpence and a shilling. He trusted that the House would not reject the boon that he was able to offer to the country.

After some further discussion, the Bill was read a second time, and the committee stage fixed for the 4th of June.

LEGAL.

The Direct United States Cable Company, Limited v. Muirhead and Others.—(House of Lords, May 21st. Before the Lord Chancellor, Lord Blackburn, Lord Watson and Lord Fitzgerald.)—This was an Appeal from a Judgment of the Court of Appeal affirming an Order of Mr. Baron Huddleston, in an action brought by the respondents to recover royalties under an agreement entered into between the parties. Mr. Rigby, Q.C., Mr. Finlay, Q.C., and Mr. Hunter appeared for the appellants; and Mr. Webster, Q.C., Mr. Moulton and Mr. R. S. Wright for the respondents. The action was brought by the respondents against the appellants to recover the sum of £1,000 for royalties under an agreement whereby the respondents licensed the appellants to use upon their telegraphic cables certain patented inventions of the respondents for the duplex working of telegraphs, in consideration whereof the defendant company agreed to pay during the continuance of the licence, and while the plaintiffs' system should operate satisfactorily, the sum of £2,000 per annum. The defendants are the owners of a cable in two sections which establishes telegraphic communication between England and America. Prior to 1877 the cable was worked upon the simplex system, whereby not more than one message can be sent through a wire at the same time. Under the plaintiffs' system two messages can be sent in opposite directions through a wire simultaneously. The defendants worked their wire under the licence from the plaintiffs on the duplex system from October, 1877, to April, 1882, when, owing to a fault in the defendants' cable involving great loss of insulation, they were compelled to revert to the simplex system. It was admitted that the cost of repairing the defendants' cable would be somewhere between £30,000 and £80,000. In consequence of this state of things the defendants refused to continue to pay the plaintiffs the £2,000. The Court below held that the fault rested with the defendants in having neglected to repair their cable, and that therefore they were bound to continue to pay the plaintiffs the royalty demanded. Their Lordships now affirmed the judgment of the Court below, and dismissed the appeal, with costs.

Colliery Explosions.—The inquiry into the loss of 40 lives at Usworth Colliery in March last has just terminated. The evidence clearly proves that this terrible catastrophe was the result of shot firing. During the last four months nearly 500 lives have been sacrificed through the use of gunpowder in coal getting. Mr. Ellis Lever, of Bowdon, who, it will be remembered, offered a prize of £500 for a perfect safety-lamp, electric or otherwise, has offered a similar sum as a premium for the invention or discovery of a safe and efficient substitute for gunpowder.

REVIEW.

Anleitung zur Errichtung und Instandhaltung oberirdischer Telegraphen und Telephon Linien aus Lazare Weiller's patent Silicium Bronze Draht. Bearbeitet nach Mittheilungen erfahrener Fach Ingenieure. Von *J. B. GRIEFF. Vienna: L. W. Seidel and Sohn.

We have here a practical treatise on a material which is already coming into extensive use, and which evidently deserves serious consideration. None of the materials commonly employed for extended electric conductors are fully satisfactory. Iron offers too great a resistance, and in spite of all preservative coatings rapidly becomes oxidised and corroded; copper, unless very thick—and therefore costly and heavy—is too weak, apt to stretch, and on prolonged use becomes hard and brittle. The new material, silicon-bronze, an alloy or compound of silicon and copper, seems to unite the good properties of other materials without their defects. It possesses practically "the toughness of iron, the elasticity of steel, and the conductivity of copper," and has in addition the advantage of being rust-proof. It becomes, indeed, like all bronzes on exposure to the air, covered with a so-called "patina," which is an insulator; but this patina, unlike the rusts of iron or even copper, does not eat into the body of the wire and bring about its destruction.

The inventor, Lazare Weiller, is well known to many electricians and engineers as the introducer of "phosphor bronze." Excellent as this latter material is for many purposes, it does not work up well into wires. Its different portions are not perfectly homogeneous, and in consequence they differ both in conductivity and in strength.

Silicon bronze is free from these defects. It is composed of the purest copper—the so-called "Lake Superior" brand—alloyed with certain proportions of silicon, and it is prepared in different qualities, according as the highest possible conductivity or great strength is the more essential condition.

We find here a table showing the comparative strengths and conductivities of the ordinary materials for electric conductors. Taking the conductivity of copper as 100, that of the best quality of silicon bronze —telegraph wire A—is 97, whilst that of phosphor bronze is 26, that of Swedish wrought iron 16·5, Bessemer steel 16, and patent cast steel 10·5. On the other hand, the breaking strain in kilos. per square millimetre is for copper only 28; but for silicon bronze telegraph wire A, 45. Where, again, great strength is more essential than high conductivity, there is a grade of silicon bronze wire, "special telephone B," which has a conductivity of only 20, higher than any iron or steel; but its strength is 112·5, as against 95 for patent cast steel. Hence silicon bronze can be obtained considerably stronger than any other kind of wire or rod, and still more conductive than any save pure copper and phosphor bronze.

Another important table gives a comparison between the weights of the various kinds of iron and steel wires per 1,000 metres run, and those of silicon bronze wires capable of being used in their stead. It will be found that the iron and steel range from three to nearly six times the weight of an equivalent quantity of silicon bronze. Hence, even leaving out of account the greater permanence of the latter material, its use must involve a notable economy in the first installation of a telegraphic or telephonic system under the heads of labour, carriage, and supports. This feature is one of the highest importance in case of military telegraphs.

A special chapter calls attention to the advantages of silicon bronze wires for deep-sea telegraphy, and certainly a material possessing such advantages deserves the careful attention of electricians.

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* Instructions for the Installation and Maintenance of above-ground Telegraph and Telephone Lines of L. Weiller's Patent Silicon Bronze Wire. Edited from the communications of experienced specialist engineers. By J. B. Grieff.

NOTES.

The Electric Light in the Royal Navy.—Various improvements have been made in the electric light apparatus on board the turret ship *Rupert*, at Portsmouth, the result being highly satisfactory. Experimental trials and instruction on the electric light are now given every evening at Devonport, on the *Scourge*, tender to the *Defence*, torpedo school of instruction ship, Commander Norcock.

Electric Lighting at Eastbourne.—The central station of the Eastbourne Electric Light Company, consisting of extensive premises at the north end of Junction Road, were formally opened on Saturday evening last, when the ceremony was attended by a large company, including the Mayor (Mr. G. A. Wallis), the Chinese Ambassador (Marquis Tseng), several local clergymen and members of the Town Council. The proceedings consisted of a concert, a *soiree*, and a public meeting, the chair being occupied by Mr. Alderman Boulton, chairman of directors, who, in the course of a few observations, expressed the opinion that the electric light would be in far greater use at the present time had the Government accorded it more encouragement. As it was the Electric Light Bill had, in some measure, destroyed enterprise in that direction. Mr. Hammond, of London, then explained at considerable length the development of lighting by electricity in England; and referring to Eastbourne, said that in spite of the initial losses which had been experienced, owing to the great expense attending the acquisition of machinery, plant, &c., the company was now in good working order, and about to pay some good money to the shareholders. There were no restrictions as to the electric light in America, and consequently it had been a far greater success than in England, there being in New York no less than 12,500 lights produced from one centre. A short address was also delivered by the Mayor, to whom a vote of thanks was accorded for his presence. With regard to the new works, it may be stated that the engine shed has an area of about 1,800 square feet, and in it are four large engines, three of which are already at work, the fourth being reserved for any emergency that may arise. It being absolutely essential that the motive power should be regular, and in constant work, each of the engines is provided with an auxiliary donkey engine, which would be utilised in case of a breakdown. The machines for producing the electric current are of the "Brush" pattern, 40-light size, and are each capable of driving 40 arc lamps or 600 incandescent lights. All the machinery stands on concrete foundations, 42 inches deep; and the dynamos rest on a well-insulated wooden floor. The wires are led away from the dynamos to a switchboard, where every wire in the circuit can be connected or disconnected from any particular machine; the switchboard is numbered, and its action perfectly controlled. A current indicator shows at a glance the strength of the current. The wires are all taken to the test room, where they are connected with another switchboard, and in this apartment the condition of the wires in all parts of the town can be readily ascertained. Over the shed in which the engines are kept, it should be mentioned, there is a large tank capable of holding upwards of 4,000 gallons of water, which is pumped up from a well on the premises, and in order to accomplish this a small extra engine is used. Already, no less than seven miles and a-half of wire have been laid down in different parts of Eastbourne, and now the new station has been completed wires will be extended to all parts of the borough.

Electric Light Meters.—The electric light meters of the Edison Companies in America do not seem to give universal satisfaction to the customers. One firm found its bills increasing about $1 a month, and this continuing, they took out the movable lamps and used gas. Nevertheless the electric light bill for the next month was nearly $1 more than for that preceding.

Electric Lighting in Paris.—A provisional installation comprising 100 incandescence lamps of 16 C.P. is in actual preparation at the Palais Royal. The works for the definite central station will be commenced later on, when the positions of 1,500 lamps of 16 C.P. have been ascertained, with a minimum of 500 hours lighting per year. This station, which is the work of Breguet's firm, will be placed outside the Palais Royal, in the locality of the Rue Croix des Petits Champs. It will comprise three 200 H.P. steam-engines and 12 dynamos—of which one engine and three dynamos will be held in reserve—as well as a set of accumulators capable of furnishing a supply of 800 lamp hours.

The following terms are given in the *Bulletin International des Telephones* as the general conditions of subscription :—Electric light is paid for at the rate of 10 centimes per hour and per lamp of 16 C.P. ; the number of lamp hours is indicated by a counter fixed in the house of each subscriber. In addition to this price the subscriber pays a sum equal to that actually paid to the Compagnie Parisienne du Gaz for the fitting up and maintenance of branches, cocks and meters. Lastly, the cost of the interior installation of the wires and lamps will be at his expense, unless a contract is made for a definite period. The furnishings and renewals of the lamps are gratuitous, except when the breakage is caused by the carelessness or negligence of the consumer. On the other hand, the subscriber participates in the profits resulting from the enterprise ; after constitution of reserve fund and deduction of an interest of 10 per cent. on the capital invested, the half of the net profit is distributed among the subscribers, under the control of the syndicate, proportionally to the quantity of light consumed by each during the year.

Electric Lighting at Grangemouth.—The docks here were successfully illuminated last Saturday night by the electric light. There are 12 Brush arc lamps suspended on 50-feet posts throughout the docks. The dynamos used are those of the Brush Corporation, with improved laminated armature. The engine, boiler, and gearing were specially built for the installation by Mr. John Bennie, Star Engine Works, Glasgow, and the work has been constructed under the superintendence of Mr. Andrew S. Dunn, telegraph engineer to the Caledonian Railway Company.

Incandescent Lamp Patents in America.—The Edison Electric Light Company of New York has commenced suits against various alleged infringers of the Edison patents for incandescent electric lighting, and against a representative number of users. The companies sued are the United States Electric Lighting Company, the United States Illuminating Company, the Consolidated Electric Light Company, the Swan Incandescent Electric Light Company, the Remington Electric Light Company, and the Schuyler Electric Light Company. $15,000,000 of invested capital are said to be directly affected. According to the solicitor of the Edison Company, Mr. Edison's claims in his original patent are for "an electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistance," and "the combination of carbon filament with a receiver made entirely of glass and conductors passing through the glass, from which receiver the air is exhausted." The United States Electric Lighting Company has brought suits against the Edison Company upon patents granted to H. S. Maxim, M. G. Farmer, and Edward Weston.

The "Valve" Telephone Instruments.—In last week's list of specifications issued by the Patent Office were two of Professor Silvanus Thompson's for improvements in the "Valve" transmitter and the "English Mechanic" receiver. These appear to be so slight in themselves as to make it scarcely worth while to devote special attention thereto ; they will therefore, in due course, appear amongst our abstracts of specifications.

Electric Lighting in Hotels.—A very interesting installation has just been completed by the Edison Electric Company in a magnificent hotel in Paris. The motive power is furnished by a gas engine with two cylinders. This engine actuates an Edison dynamo for 60 A lamps, which may, if desirable, be directly used with the incandescence lamps ; but generally it serves to charge a battery of Faure-Sellon-Volckmar accumulators. In such an installation the lamps have not to act simultaneously, except during great receptions, and ordinarily the number of lamps in use varies constantly. With the accumulators the expenditure is proportionate to the requirements of the lighting, and the economy thus realised compensates amply for the losses occasioned by the employment of a secondary battery. The lighting comprises 60 incandescence lamps, and the battery consists of 60 accumulators, which are charged during the day and discharged at night, according to requirements. These elements have a capacity of 500 ampère-hours ; they weigh 70 kilogrammes each, and their rate of charge varies between 27 and 30 ampères. At the commencement of the discharge 56 elements are sufficient for supplying the lamps ; the other four are held in reserve, and added according to the amount and duration of the lighting.

The Use of the Telephone at Aldershot.—The utility of the telephone is now being recognised in the military offices at Aldershot, where it has to a great extent supplanted the simple A, B, C Telegraph. For some time past the Royal Engineer Department has been busily engaged in fitting Gower-Bell instruments, and already communication by telephone has been established between the offices of the Assistant Adjutant-General, the Royal Engineers, the Transport Office, and the Commissariat Supply and Ordnance Store Depôts.

Telephonic Transmitters.—We believe that the transmitters employed by Messrs. Bassano and Slater, in conjunction with the receiver described in our current columns, are of carbon, but without any attachment thereto which can be defined as a diaphragm.

Magneto Bells for Telephones.—Messrs. Blakey and Emmott are just introducing a small magneto bell which is said to be specially adapted for use with telephones over lines up to about 6 miles in length.

The Proposed Cable to Singapore.—Telegraphing last week from Singapore, a correspondent of the *Times* stated that no action has yet been taken by the home Government in the direction of constructing an independent cable to Singapore, and the delay is much deprecated there.

A Magnetic Experiment.—Dr. Gross, a German physicist, has made a curious experiment which, says *Engineering*, is not easily explicable by known facts. He placed two electrodes of iron in a vessel of chloride of iron solution, and inserted a galvanometer in circuit, adjusting the current by the Poggendorf Du-Bois Raymond method. One of the iron electrodes was then surrounded by a magnetising spiral, through which a current was passed, and it was found that the galvanometer indicated a new current flowing from the electrode that was magnetised through the liquid to the electrode that was unmagnetised. The magnetised electrode was kept cool by circulation of cold water, and Dr. Gross does not think that the effect was thermo-electric. When the electrodes were placed in the plane of the axis of the vessel (in this case a tube) with their ends pointing to each other the current was observed to flow through the cell from the non-magnetic to the magnetised electrode.

Clark's Electrical Gas Igniters.—What an improvement these instruments are upon the older form of apparatus, containing an induction coil and small galvanic batteries ! We have had one of Clark's patent gas lighters in constant use for nearly 12 months, and to all appearance it will last for many another year.

The Electrical Distribution of Power.—A new system of distribution, exhibited lately at the Technological Museum at Vienna, is now to be seen at the Buda Pesth Exhibition, where it gives good results. This system, invented by Messrs. Zipernowski and Déri, was suggested by that of Messrs. Gaulard and Gibbs, but it differs from it in the construction of the secondary apparatus, by their arrangement, and by the means of regulation employed. According to M. Rothen, who has examined it, the process seems to fulfil the following conditions :—1. The expenditure of the current is proportional to the number of lamps introduced, and the changes produced in the circuit of a transformer have no effect upon the circuits of the other transformers. 2. The consumption of motive power is proportional to the amount of work done in the circuits of all the transformers. 3. The system requires no automatic regulators, which are not always sure in their action, and often require, in consequence, special superintendence. 4. The system of distribution is relatively cheap. It appears, in fact, from the first experiments, that the various circuits work in a completely independent manner ; in the installation at the Technological Museum, with 404 lamps in use, 402 were extinguished, and the remaining two burned as before. As to economy, the system seems also to be very advantageous. The inventors think they can obtain a return of 95 per cent.

Something like a Conductor.—A new wire is spoken of in America having peculiarities which have hitherto been unknown in this connection. The copper wire, which is considered by the inventor as a secondary affair, is surrounded by powdered carbon, and this in turn by wrapping, and an outer insulation of what seems much like oakum. But insulation is not the inventor's best hold. He has discovered, writes our American namesake, that carbon is a conductor of that peculiar nature which is competent to do away with induction. The earth is the only conductor which can completely subdue this "electrical tramp," and carbon is the next best material. The carbon, too, has another special property, which has hitherto been hidden beneath a bushel, and which is one of magnificent proportions. It has the singular faculty of fishing up and appropriating electricity when there is a current traversing it, and thus not only supplying any lost current, but actually increasing the battery impulse, so that at the end of the route there is more force than was originally sent to line. It acts something as linsey woolsey trousers do when a boy is chasing a calf through a briar patch, or an Indian pony's tail operates among burdocks. According to the theory, this wire, to sum up its qualities, which are the nearest approach to perfection yet reached, it does away with induction, it accomplishes by renewal the effects of leaks, thereby rendering long distance telephone, telegraph, and electric light circuits practical and easier than short ones, and at the same time cheaper ; and it knocks Sir Wm. Thomson's formula for finding the most economical weight of metal for the transmission of electrical power silly and cold, inasmuch as only wire enough is required to insure connection and bridge over faulty spots in the carbon core.

The Jablochkoff Battery.—We are at present making some experiments with this battery constructed according to the inventor's description in *Comptes Rendus*, and when these are completed, which will be in a few days' time, we hope to be in a position to show that the "auto-accumulator" of M. Jablochkoff is no real advance in primary batteries.

Trembling Bells.—We mentioned amongst our Notes last week that Mr. Jolin had devised a method of ringing a number of trembling bells in series, which created some little interest amongst the members of the Physical Society during their recent visit to Bristol. This arrangement will be found illustrated in our current number.

On Charging Secondary Batteries.—We publish in our other columns an interesting paper by Mr. W. H. Preece, F.R.S., which will give the users of secondary batteries some useful information as to their management. What the new facts are, however, which have developed themselves in Mr. Preece's installation during the past twelve months we fail to see, for we think all the points brought forward by him are well known to those who have experimented with these batteries. Doubtless some of our readers can very well explain the apparent diminution of internal resistance observed by Mr. Preece, but it would be desirable to know by what method he arrived at the resistance of the cells.

The Progress of Electric Lighting.—A well known pioneer of electric lighting in Great Britain made the remark at a public meeting in Eastbourne the other day that this industry owed its greater success in America to the absence there of an Electric Lighting Act. This may be true to a certain extent, but there are many other equally good reasons which might be brought forward. It appears, however, that the business-like capacity of our transatlantic cousins in turning any new invention to account is likely to receive a check in this direction, which may lead to grave results. If Edison's suits should be successful against his enterprising rivals, electric lighting in the United States will assume much the same position as telephony now occupies in this country, a position which discourages all attempts to extend the usefulness of that art. It may, indeed, have the effect of creating a monopoly in the electric lighting industry here, although this is a contingency which does not at the moment look probable.

Tenders for Telegraph Stores.—The directors of the North Eastern Railway are prepared to receive tenders for a supply of telegraph stores, concerning which full particulars may be found in our Advertisement columns.

A "Telpher" Line for Sussex.—Considerable interest has been aroused by an experiment which is shortly to be made at the Sussex Portland Cement Works, at the small village of Heighton, near Newhaven. It is proposed to carry the clay from these works by electricity. A "telpher" motor, running on a single steel rod, is to serve as a locomotive, dragging behind it a number of trucks. The line, which will be formed of a ¾-inch steel rod, resting upon cast iron saddles, and supported by braceposts and a crossbeam, will be raised, as a rule, about 12 feet above the ground, but in some instances 16 feet. The supports will be about 66 feet apart. There is to be an "up" line and a "down" line. It is stated that it is incomparably cheaper to build a "telpher" line in the air than to lay a line of double rails on the ground, requiring bridges, foundations, &c. The engine is stationed near the Glynde station at a point where the telpher line crosses the Glynde reach. The buckets conveying the clay are carried to the special siding, where they tip themselves over and empty their contents into the trucks held in readiness beneath, and which are in due course run along the railway to the Heighton Works. So confident is the company controlling Professor Fleeming Jenkins' patents of the success of this new method of locomotion, which is now to be tested for the first time on a large scale, that it has undertaken to erect the Glynde line entirely at its own expense, and to take all risk. It has also bound itself to convey for a year 150 tons per week of the clay, and if not successful in so doing to bear the entire loss.

Petroleum v. the Electric Light.—The Eastern Arcade of the Inventions Exhibition is at present illuminated by 22 Defries' safety lamps, burning petroleum. Each lamp is said to give a light of 70 candle-power at a cost of less than one-third of a penny per hour. How does this compare with electric lighting, both by arc and incandescence ?

The Electric Railway at Brighton.—A lengthy discussion took place at the last meeting of the Brighton Town Council with reference to Mr. Volk's electric railway. A motion was introduced by Councillor Daniel to the effect that an instruction should be given to Mr. Volk to remove and clear away by the 30th of September next so much of his electric railway as lies between the Old Pier and Paston Place. He argued that owing to the railway, Madeira Road, which had previously been thronged with visitors, was now almost deserted, and he said that Mr. Volk had partially destroyed the beautiful gradient that was made at Kemp Town. The railway was a constant source of danger, as it frightened horses, and he would rather that they compensated Mr. Volk against any loss than that matters should remain as they at present were. The road having been destroyed by the action of the railway, he thought it was the duty of the Council to have it removed. Councillor Berry seconded the resolution. Several members stated that no danger had hitherto arisen from the railway, which was a valuable attraction. Councillor Hall moved an amendment to the effect that the Works Committee should be requested to bring up a special report on the subject, and if it was resolved to continue the railway, suggest the terms that should be charged for the site. Councillor Dr. Ewart, who seconded, described the railway as an "unmitigated blessing." Alderman Lamb said that after the short piece of line was tried as an experiment the Council thought it should be extended and turned into something useful, and consequently Mr. Volk extended it. That it had proved useful was shown by the fact that in twelve months 250,000 people had travelled upon it. Mr. Volk had laid out £3,500 on the railway. Petitions in favour of the railway had been signed by 6,000 people, and he believed nine-tenths of the people in the East-end of Brighton would be in favour of its continuance. After further discussion, the amendment was carried by 34 to 10.

Notes on Electricity and Electric Lighting.—In a work entitled "Engineer Officers' Watch, Station, Quarter, and Fire Bells," compiled and arranged by Mr. William J. J. Spry, chief engineer, some interesting observations are appended with regard to electricity in the Royal Navy. The writer remarks that "the use of electricity in the naval service has within the past few years been greatly extended. As the care, management, and use of electrical appliances are now so intimately connected with the duties of a naval engineer, it is desirable that a subject of such growing importance should be carefully studied by all those connected with that branch of the service, and receive due attention from them. The four principal uses to which electricity is at present confined are:—1. For communicating between different parts of the ship by means of bells, fixed signals, and telephones. 2. For the electrical discharge of 'Whitehead' torpedoes, &c., controlled from the bridge. 3. For firing guns, torpedoes, &c. 4. For internal, auxiliary, and search lighting purposes." The writer gives concise and clear instructions as to the working of electricity for naval purposes, and inasmuch as the book is from beginning to end replete with useful information of the utmost value to those for whom it is intended, there can be little doubt that it will meet with approval. Messrs. Griffin & Co., of the Hard, Portsmouth, are the publishers; the London agents being Messrs. Simpkin, Marshall & Co.

Bagshaw's Friction Pulleys.—The whole of the power for driving electric light machinery at the Grosvenor Gallery is to be transmitted through Bagshaw's patent friction pulleys and clutches, and, in accordance with instructions from Messrs. Marshall, Sons & Co., Gainsbro', Messrs. Bagshaw & Sons are making one large clutch for 300 horse-power, and others for 150 H.P. each. The advantage of this new form of clutch is that the weight of the pulley and tension of the belt are taken off the shaft and borne by independent bearings, so that when the clutch is out of gear there is absolutely no wear and tear going on. Where broad and heavy belts are employed this is much more satisfactory than bushes of ordinary type resting on the shaft, as the pedestals may always be adjusted to keep the clutch concentric with the shaft. This arrangement has recently been applied to the new engines at *Manchester Guardian* offices, also to Bell Brothers' Alkali Works, Middlesborough, and other large works.

Lightening our Darkness.—The views taken by Col. Parnell on the subject of lightning do not commend themselves to electricians generally, but those of Mr. William Boggett, of Chelsea, are still more extraordinary. This nonagenarian has published a 12 page pamphlet, for which the modest (?) sum of sixpence is asked, entitled, "Facts Proving that Lightning is a Composite Force." In the preface he is careful to say, "My knowledge of science is very superficial, and the want of training unfits me for a proper performance of the task I have undertaken." This is very apparent, without the author's admission, as the following choice extracts will show:—"Dynamos obtain their powerful currents from the water in the earth. . . . . There can be no question that water is composed of two gases, plus electricity. . . . . A controversy continued for many years between the most eminent electricians as to the seat of electromotive force in voltaic cells; the question was advertised for discussion before the British Association at Montreal, but prior to the meeting I sent my pamphlet* to Mr. W. H. Preece, wherein, at page 24, I pointed out a complete answer to the question." Speaking of incandescent lamps, this latter day Chelsea sage says:—"There is neither combustion nor *heat*. . . . . Many years ago, a friend of mine often went to the Polytechnic Institute, where he amused himself by observing the visitors pointing their fingers at suspended electric balls, which advanced or receded according to the electric state of the visitors' bodies, and he particularly noticed that, with females, the balls moved in one direction, but with males they invariably took an opposite one. These facts have suggested to my mind the possibility of the idea being utilised for the relief of nervous and other complaints. The phenomena is clearly traceable to the fact that electricity emanating from men is distinct from that of women, and may serve to explain the reason why King David in his old age found benefit from the companionship of a young woman." Mr. Boggett then goes on to describe some experiments he tried in conjunction with his niece, but for the results thereof we must refer our readers to the pamphlet itself.

Output of Incandescent Lamps in England.—The *Electrician and Electrical Engineer* of New York thinks that the figures which have been given representing the output of incandescent lamps in England, 20,000 per week, are largely in excess of the production in the United States.

Town Lighting by Electricity.—The Dundalk Town Commissioners invite tenders for the annual lighting of the town, at present lighted by about 200 gas lamps. Population 13,000. Tenders are to be sent by 6th June to Mr. E. Ferrar, town clerk.

Lightning and the Electric Light.—During storms recently at Houston, Tex., the lightning prostrated several electric light poles, smashing lamps and globes. At the Electric Light Works the lightning played havoc with the plant, burning two dynamos out in two nights; two extra or reserve machines were also struck, and every arc light in the city was put out.

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* Published in 1884.

Thermo-Piles at the Philadelphia Exhibition.—At the late exhibition, two forms of thermo-piles were exhibited, one of the Clamond and one of the Nöe-Rebicek pattern. The first of these consisted of pairs of iron and an alloy of bismuth and antimony, arranged in rings. There were 14 rings of 11 pairs each, 154 pairs in all. The examining committee found the battery to give an electromotive force of 3·02 volts, and to have while hot an internal resistance of 2·2 ohms. The Nöe-Rebicek is a more recent battery. In this there were 20 pairs of elements, consisting of German silver and an alloy of zinc and antimony. The elements are arranged horizontally and radially at the top. The heat from the flame comes to the joints through a short, thick copper wire, which is exposed to the flame. The central disc, against which the flame strikes, also imparts its heat to these copper conductors, which point directly toward it and surround its entire circumference. The elements rest on a stiff insulating ring, which carries a series of vertical cylinders. These are rolls of sheet copper, and their object is to conduct the heat away from the elements and to convey it to the surrounding atmosphere. The elements are thus heated by a single Bunsen flame in an economical manner. Of the two batteries of this pattern tested by the committee, the larger had an electromotive force of 1·94 volts, or nearly one-tenth of a volt per pair. The smaller one gave 1·73 volts. The internal resistance of the larger was ·5 ohm, and the smaller, ·8 ohm. The committee states that the Nöe-Rebicek pile has the highest electromotive force of any similar battery that has been made on a commercial scale, and seems a long step away from the ordinary bismuth-antimony pile, and toward a thermo-pile that may be used as a substitute for the common galvanic battery.

Primary Batteries.—A Chloris Baudet "unpolarizable" battery was tested at the Philadelphia Exhibition last year. The cell is described as follows:—An outer rectangular cell, 22 cm. by 18 by 9, and a porous cell for the zinc plate. Two porous jars, one for crystals of bichromate of potash, the other for sulphuric acid; one with holes and the other without; two plates of carbon, each with suitable wire connections, and a suitable cover for the whole. The solutions used were a saturated solution of bichromate of potash for the outer jar holding the carbon, and a supersaturated solution of acid sulphate of potash for the porous jar containing the zinc. In the test cell the bisulphate of potash was used in the porous jar. When first set up this cell had an electromotive force of 1·87 volts. It was then put in circuit with a resistance of 5·8 ohms, including a galvanometer, when the deflection was 47°, with a current of ·262 ampère. The internal resistance of the cell was 1·3 ohms, and the zinc was a half-inch rod immersed to a depth of about three inches. The needle fell one degree in the first five minutes, when after an hour it rose to 47½°, standing steadily for five hours; the next morning it was 45°. Here it remained practically constant for about 28 hours, when it suddenly fell.

A Cat's 300-Mile Spin.—The central station of the Municipal Electric Light Company is in South Fifth Street, Brooklyn. The engine which furnishes the power has a large fly-wheel, which runs in a pit. When the engine was started one night, says the *Mechanical World*, a cat, which made its home in the station, was on one of the spokes in the pit, out of sight of the engineer. The wheel was soon making 20 revolutions a minute. It was impossible to rescue the cat from its perilous position without stopping the engine, and that would break every circuit and put out all the lights dependent upon the dynamos in the station; so the unfortunate animal had to ride on until the engine was stopped at the usual hour for putting out the lights. The cat then dropped exhausted from the wheel, but soon revived, and was none the worse. It is estimated that the animal travelled 300 miles on the wheel.

The Electric Light in Flour Mills.—Speaking about dust explosions, says the *Milling World*, a case from Germany is worthy of notice. A sack of flour, falling down stairs, opened and scattered the contents in a cloud through the lower room, where a burning gas flame set fire to the dust, causing an explosion which lifted a part of the roof of the mill and broke almost all the windows. There can be no doubt that the majority of dust explosions are, like mine disasters, due to open lights, and as this danger can be practically avoided by the use of the incandescent electric lights, there really seems to be no valid reason why it should not be introduced more generally, as those establishments which have used it express themselves in its favour. No matter how carefully other lights are guarded, an absolute safety, as long as the globes are intact, is offered only by the incandescent lamps, where the atmosphere or the dust has no access whatever to the flame. The above instance teaches also how little is necessary to start an explosion in the cleanest mill so long as open lights are used; how much greater must the danger be in establishments where the air is constantly charged with dust, and where cleanliness is looked upon as of minor importance!

An Exhibition at Liverpool.—Next year there is to be an "Exhibition of Navigation, Travelling, and Commerce" at Liverpool, at which, it is said, the electric lighting exhibits will be important. A guarantee fund of £25,000 has already been raised.

Electric Lighting Provisional Orders.—The Board of Trade has revoked the Canterbury Electric Lighting Order, granted two years ago.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Jablochkoff and General Electricity Company, Limited.—An agreement, dated 16th inst., and filed on the 18th inst., cites, that for good and valuable considerations the company will issue fully paid shares as follows, viz., to Mr. Wm. George Ainslie, of Furness Lodge, East Sheen, 32 shares; to Mr. Charles John Taylor, of 50, Courtfield Gardens, South Kensington, 9 shares; and to Mr. John Toulmin Lawrence, of Annandale, North End, Finchley, 1 share.

Western Counties and South Wales Telephone Company, Limited.—The statutory return of this company, made up to the 28th ult., was filed on the 5th inst. The nominal capital is £400,000, divided into 20,000 preference shares of £5 each, and 300,000 ordinary shares of £1 each. 4,061 preference shares have been taken up, and £1 per share has been called and paid thereon. Registered office, 16, High Street, Bristol.

An agreement, dated 21st inst., and filed, with the registered documents of the company on the 22nd, provides for the allotment of 160,000 fully paid ordinary shares to the United Telephone Company, 50,000 fully paid ordinary shares to Mr. G. Hunter Robertson, and 65,000 fully paid ordinary shares to Mr. Douglas Methuen Forsyth. The latter shares are for issue to the subscribers for the first issue of 10,000 6 per cent. preference shares in the proportion of three fully paid ordinary shares for every preference share taken.

Oriental Telephone Company.—The annual return of this company, made up to the 12th inst., was filed on the 19th inst. The nominal capital is £300,000, in £1 shares. 297,990 shares have been taken up. Upon 222,000 ordinary shares 11s. per share has been called, upon 2,990 shares £1 has been called, and 75,000 vendors shares are fully paid. The paid up capital is £198,006 13s., leaving £983 7s. unpaid.

Bullion and Metal Refinery Company, Limited.—The registered office of this company is at 11, Delahay Street, S.W.

CITY NOTES, REPORTS, MEETINGS, &c.

Consolidated Telephone Construction and Maintenance Company, Limited.

THE fourth ordinary general meeting of this company was held at the Cannon Street Hotel on Tuesday, under the presidency of Mr. C. L. W. Fitzgerald, chairman of the company. There was a large attendance of shareholders, to whom was submitted the directors' report, published in our last issue.

The Secretary, Mr. Charles Curtoys, having read the notice convening the meeting,

The Chairman said: We, your present board, have done our best to present to you as intelligible a balance-sheet as we possibly could. As you are aware, these accounts are of a rather complicated nature, and it has cost us no little labour and trouble to reduce them to something which one can fairly understand. I should like to point out to you two or three things in the balance-sheet, and in the revenue account. First of all you will see that the capital has been reduced according to the resolution of the meeting in December last. A little lower down, on the credit side, you will see a large item standing as "subsidiary companies, £47,000." That item will be expunged when we hold the next meeting, and in place of that will appear 32,500 five per cent. debentures of the Austrian Telephone Company, and 20,000 five per cent. preference shares of the Edison-Gower-Bell Company. I think we may feel pretty safe with regard to these: the interest on these debentures and preference shares will undoubtedly be paid. We have separated the ordinary debtors of the company from the subsidiary companies, and that amount of £4,394 is from the companies in England, and one or two other companies. Our principal debtor really is the United Telephone Company, of course, as it does the largest business in England. We should have been very much gratified indeed had we been able to pay you a dividend; but the fact of the matter is this, that the requirements of this business are so vast that I think it would be undesirable, when we have just rescued the company practically out of the Bankruptcy Court, to divide up the little profit we have made. If you turn to the revenue account you will see that the manufacturing profit was £8,300. After certain expenses, and writing off from that profit £1,500, goodwill and patent rights, we have a balance of £5,200. Now, gentlemen, I can point out to you a mode of paying a dividend, if it please you to accept it, and it is by the shareholders of this company purchasing from the company some of these River Plate debentures. The £14,000 standing to the credit of our securities, I am informed by the auditor, is available for sale and division amongst you as a profit to the extent, perhaps, of about £5,000. Otherwise it would be unadvisable to divide up the small profit we have made, for, as I shall point out to you, our business is not alone a manufacturing business; we have three very important businesses abroad. When I say that, I mean that we have subsidiary companies. These companies have large and widely-extending businesses. If we do not support those subsidiary companies you will find that our business in the future, when the term of the patents expires, will diminish very much; and I have always my eyes fixed upon that point, that we must get a large proportion of our profit from the income to be derived from the businesses abroad, the River Plate Telephone Company, the Austrian Telephone Company, and the Edison-Gower-Bell Telephone Company, in Portugal. I will now just point out to you a few items in the revenue account. As regards legal expenses we shall not again have to incur a gigantic amount like that. £900 really has been paid; there was a certain sum reserved from last year's accounts which it has fallen to the duty of this board to pay. Then the expenses of the committee of investigation will not occur again. When we next have to present the accounts that side will be much more favourable. I feel myself that it will be; and not only that, I mean to do my very utmost to reduce the expenses as much as possible. The next point I will speak of is the subject of manufacturing. As to the whole of the manufactures, I am very happy to state that we are doing a large and increasing business, and, so far as we can judge, that business will increase more and more. Our output every week is certainly very good now. When I first joined this board it was a very small item, sometimes going down to only £100; now we run up to £1,000 a week. I fancy that the cause is the extension of the radius that the Postmaster-General has granted to the telephone companies. In America, in looking through a report from there, I find there are in the United States 128,000 telephones running; in the United Kingdom there are only 12,000. Surely in the five years to come, while we are the sole manufacturers, the telephone must make a start in England. I should think it must; at all events, we must hope it will. I should tell you that we have at this moment a large order from the Postmaster-General. Mr. Preece, the electrician, has stated to me that he has never had a better instrument turned out of a factory than he has at this moment; he is extremely satisfied. We have, also, independent testimony from Sydney, Australia; gentlemen there are using the Consolidated telephone in preference to any other. The Canadian Government have ordered of us lately a small quantity of instruments, and with the order they sent a letter saying that they are highly pleased with the transmitting power of this instrument, and we look to that to give us some substantial orders in the future. Abroad, there is not the slightest doubt we could do a large business, but at a very small profit, and I think it would be unwise to press that business too much. We are doing business on the Continent. I have received offers to do business for Sweden, Italy, and Holland, but the profit is so small that while we have a fair amount of business here to occupy us I think it would be unwise; but it has our attention. We have entered into negociations with a certain body of gentlemen to execute a large order from Canada. If we get that order that will take up a considerable time; it takes a considerable time to manufacture 1,000 telephones. Before I quit this subject, I cannot help saying a word of praise for our general manager, Mr. Mason. I assure you we are all indebted very much to Mr. Mason for the manner in which he has worked our business. Now, gentlemen, I will say a word or two on the subject of the exchanges abroad. You see at the end of the report we give you a statement of what we have done in the course of the year. Now, I think that alone as a business should prove highly satisfactory. We have increased the subscribers to the exchanges by the number of 914, with an annual income of £6,472, and that has been done at a capital expenditure of about £22,000. A return from Austria which the manager at Vienna has made states that we have there no less than 870 subscribers, and that we have 284 people waiting to join the exchange. I should like to point out to you that, according to the estimate of the manager at Vienna, when we have 1,100 subscribers connected up and paying the revenue of the Austrian Company will be £9,000, and the working expenses £3,870, leaving net profit of about £5,000. I think if we consider that all these exchanges abroad are gradually working up to a paying position, we have every reason to congratulate ourselves, because in course of time, there is no doubt, this business will be returning us large profits. One of the directors, Mr. Bateman, went out to Austria to see what the business was, and he has come back with a very high opinion of it indeed. There is no doubt that we have, through introductions which members of this board have obtained, got into communication with the Minister of Commerce in Vienna, and we have improved the status of the company by doing so to an enormous degree, because, as you are well aware, at one time the business relations between the Government and this company were very nearly being broken off altogether. In Lisbon and Oporto matters are progressing very satisfactorily—an increase of 284 subscribers with a gross increase of £1,559 rental. There is no particular point to allude to there, except that the Edison-Gower-Bell Company is remitting money home. Mr. Danvers reports: "We hope to be able to send you from £2,500 to £3,000." From the River Plate we heard this morning from Mr. Powers, who says everything is going on splendidly; and he says the exchange question is injuring us to a great extent, because there is no possibility of sending back money from that part of the world with the 33 per cent. against you. We at the present moment are examining closely into the details of all the businesses, and I hope and trust that with the continued increase of the manufacturing business at home and abroad, and with all the exchanges working and paying concerns, that the absolute success of the Consolidated Company will be secured. I believe it will be. Anyhow, we shall do all in our power to keep this business in a sound state, and not let it lapse again. I shall now propose, "That the directors' report and statement of accounts for the past year be received and adopted."

Mr. John Taylor seconded.

A Shareholder asked what was about the value of the telephone.

The Chairman: I have known them bring as high as £20.

Another Shareholder enquired the value of the order from the Canadian Government.

The Chairman said the question was rather inopportune, and he did not think it advisable to answer.

Mr. Perry: You told us you had some expectation that the two companies in the River Plate would amalgamate, and that that would be a great benefit to us. I wish to ask you, also, whether you cannot raise your rates. The railways in the Argentine Republic are raising their rates.

The Chairman: So far as the amalgamation is concerned, the opposition are willing to amalgamate, but they want what I call such bad terms to our company that we do not think it advisable. I believe the chairman of the United Company, the opposition, will be in London next month, and no doubt Mr. Taylor, the chairman of the River Plate Company, will see him, and see whether we cannot get some better terms. As to raising the rates, that is rather an awkward thing to do when you have an opposition; in fact, a very dangerous thing to do. I should like to, as a matter of fact. I should like to raise the rates in Austria also, but I am afraid it is rather dangerous.

Mr. A. H. Pinto: I notice that this company holds some £214,000 worth of shares in subsidiary companies. Is there any value attached to those shares?

The Chairman: That is a very awkward question. You may judge of the value from the fact that the companies are every day improving and paying dividends. It is a question I don't see how I can possibly answer.

Mr. Pinto: Are they negociable at all?

The Chairman: I don't know. We cannot negociate them, because we can't sell them very well at a discount.

The resolution for the adoption of the report was then carried unanimously.

Major Fitzgerald and Mr. Van Zeller having been re-elected directors, and Mr. J. G. Griffiths and Mr. A. E. Green auditors,

Mr. A. H. Baker, a director, said: One of the shareholders has inquired as to the value of the assets we have got in the way of subsidiary companies. I think, judging from the success which has attended the working of those different companies for the last year, if they go on in the same ratio, their value is very considerable; and not only will they pay the fixed charges, the interest on the preference shares, but also a considerable dividend on the ordinary shares, which we have not valued at all.

Mr. Pinto asked if it was the intention to write off anything more for patents and goodwill.

The Chairman thought that was a question for the auditors.

Mr. Griffiths, one of the auditors, said it was on their recommendation that a charge was made against profits in the sum of £1,500. As a matter of fact, the patents were dying out, as all patents did, and, though the goodwill was improving, he thought that for years to come some little provision out of the profit and loss would have to be made.

The Chairman thought this touched on the value of the shares in the subsidiary companies. They had standing against goodwill and patent rights £87,000, but against that they had £214,000 in shares of other companies. If those shares were worth the £87,000, they would not need to write off very much more. But it was difficult to judge, and he supposed they must continue writing off.

A vote of thanks to the chairman and board terminated the meeting.

South of England Telephone Company, Limited.

THE statutory meeting of this newly-incorporated company was held at the Cannon Street Hotel on Thursday, Mr. Robinson Kendal presiding.

The Secretary having read the notice convening the meeting,

The Chairman said the meeting had been called in conformity with the Companies Acts. It was what was called the statutory meeting, and had to be held within four months of the incorporation of the company. Practically there was no business to be brought before the shareholders, but as they were assembled, perhaps it was as well that he should give them a few facts and figures in regard to their own company in particular, and also in regard to the present position of the telephone in this country. The Parliamentary Committee which had so exhaustively discussed the question of overhead wires, had reported very favourably in connection with telephony; in fact, so favourably, that the companies had nothing to complain of. The local authorities and public bodies had hitherto placed serious obstacles in the way of telephonic enterprise, but after the decisive report of the Parliamentary Committee, he thought those obstacles would be largely removed, and in future they might look for a degree of tolerance, if not of favour, from the public authorities. The fetters, and perhaps the shackles, with which telephonic enterprise had been surrounded since its introduction into this country by the Post Office authorities had now also disappeared, and practically the telephone companies had little or nothing to complain of—little or nothing compared with what they had twelve or eighteen months ago. As an instance of this, he was at Cambridge a little while ago, and there met the representatives of the Town Council and of the Improvment Commissioners, and after discussing the question of introducing the telephone for some time, they agreed to warmly support their system, and promised them every assistance in their power. The same thing had happened with regard to other places. At first, owing to the perversity of human nature or other causes, when it was attempted to introduce a telephone system the system had met with obstacles, and, in fact, the local authorities had set about cursing its introduction; but in every case, what they commenced by cursing they ended by blessing, and they were now glad to adopt the system for their fire alarm systems, and for other municipal purposes. But there was still a vast degree of ignorance in the country as to what the telephone really was. In a large town within forty miles from London, to which they recently sent one of their local managers to open up the system, the chief personage of the place inquired whether the manager had brought any testimonials showing what the telephone had done in other places. Their representative replied that he thought the telephone was known all over the world, but he was assured that in that place they knew nothing at all about it. With regard to this particular company, they had a very large district, which had hardly been developed at all. The district comprised the counties of Northampton, Norfolk, Bedford, Cambridge, Huntingdon, Buckingham, Oxford, Berks, Suffolk, Sussex, and such portions of the counties of Kent, Essex, Surrey, and Hertford as are not in the metropolitan area of the United Telephone Company. Their company was only registered some three and a half months ago, and it was practically only six or seven weeks since they began actively to work in connection with the development of the district, and he ventured to think that during that period they had not let the grass grow under their feet, but had actively and zealously endeavoured to carry out the work entrusted to them. They had run numerous private lines, which would be most profitable to them, and he saw no reason why that part of the business should not be largely developed, so that in time there would be in almost every well-to-do man's house a telephone, and the public institutions in every town and the various shops and offices in connection with the community around. They had a tolerably large, successful and improving exchange at Brighton, which had something like 200 members already; the subscribers were almost increasing daily, and he looked forward to the time when that exchange will be a very great success, and play an important dividend-earning part to the company. There were exchanges also at Norwich and Ipswich; that day (Thursday) they opened an exchange at Chatham and Rochester, which promised to be one of the most successful in the district. In five or six days they expected to open exchanges at King's Lynn and Hastings; and they had taken premises and hoped to commence operations within ten days at Reading, Northampton and Cambridge. He looked forward to the time when at Cambridge the system would not only extend over the whole town, for he believed they would have the opportunity of seeing what could be done in the way of developing telephonic enterprise as it might be shown in the internal arrangements of the various colleges and houses of the neighbourhood. Hitherto the telephone had been confined largely to exchanges, but there was no reason why that should be so, no reason why the telephone system should not be so developed that almost from house to house, and room to room, there should be connection, just as completely as subscribers to exchanges were now connected. They expected before long to make satisfactory arrangements with respect to different trunk lines between London and outlying districts. They had made enquiries to see whether they could not run wires between London and Chatham and other districts, and he believed they would be able to run such wires in a business-like manner, and make them pay. Without taking into account any prospective business likely to accrue from the opening up of those exchanges, he might tell them that, from rentals and from orders in hand, their income for this month amounted to more than £750, which he thought, considering the short time they had been in existence, was very satisfactory indeed. There was no reason why this income should not increase month by month; if it did not it would be no fault of the directors. They had engaged a number of active, zealous, and experienced young men, and with the assistance of these he hoped they would be able to develop the district and produce satisfactory results.

Mr. Bevis asked how many towns were now connected with London.

The Chairman: At the moment we are only connected with Brighton, and we think we have done good work to be connected with Brighton; but we have it in contemplation to connect Reading and Chatham.

Mr. Bevis: Of course, Northampton is too far? It is a very important town.

The Chairman: I would not say Northampton is too far. It is so in this respect, that we do not intend to commit ourselves to enterprises of this kind without a guarantee of a sufficient number of subscribers to make it a paying operation.

Mr. Bevis then enquired the number of shares allotted.

The Chairman replied that there was something like £30,000 of capital issued. They had quite sufficient money for their immediate purposes, and did not contemplate that they should require any more for a tolerably lengthy period.

There was no further business, and a vote of thanks having been accorded the chairman, the meeting ended.

Blackpool Electric Tramway Company, Limited.

A STATUTORY meeting of shareholders in this company has been held at Blackpool, Mr. R. Horsfall (Halifax) presiding.

In the course of his remarks the Chairman said that only half the capital (£30,000) had been called up. They found, however, that they would require something like £16,500 to complete the works and provide rolling stock, and they had decided to borrow the extra amount rather than call up an additional £1 per share. They had set out with the intention of having the line completed by June 1st. Circumstances had, however, prevented that, but they had that day made arrangements by which the line would certainly be completed and in working order by the 1st July. The Prince of Wales was to visit Preston on the 2nd July, and if His Royal Highness was induced to visit Blackpool on that occasion they certainly would be ready to receive him.

In answer to a question, the Chairman said that the directors had not the slightest doubt that the electric tramway would be a complete success.

United Telephone Company, Limited.—It has been decided by the directors to make a call of 10s. per share on account of capital on the 20,000 shares of £5 each, numbered 80,001 to 100,000, issued at £2 premium, which will make the amount called up stand at £2 10s. on account of capital, and £1 on account of premium, leaving £2 10s. on account of capital, and £1 on account of premium still to be called up. The present call is payable on August 1st.

Anglo-American Brush Electric Corporation, Limited.—In our earlier issues last week we announced in error the notification of a further issue of 6,695 fully paid shares of this corporation. It should have been stated that application had been made to the Stock Exchange Committee for a quotation and settling day for those shares.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending May 22nd were £2,706, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

PROCEEDINGS OF SOCIETIES.

Physical Society, May 23rd.

Prof. GUTHRIE, President, in the Chair.

Dr. A. H. Fison was elected a member of the society.

The following communications were read:—

"Experiments showing the variations caused by magnetisation in the length of iron, steel, and nickel rods," by Mr. SHELFORD BIDWELL. The subject of the extension and retraction of bars of iron and nickel under the action of magnetic force has been investigated by Drs. Joule and A. M. Mayer, and by Mr. Barrett. In the present experiments the magnetising force has been increased with the result of bringing out some striking and novel characteristics. The apparatus employed consisted of a vertical magnetising helix, considerably longer than the experimental rod, the latter forming the central portion of a compound rod, the two ends being of brass. The lower end of this rod is plane, and stands on a firm support; the upper end is a knife edge, which bears against a brass lever 18 cm. in length, about 1 cm. from the fulcrum; the portion of the rod to be examined is in the central portion of the helix. The above lever is furnished with another knife edge at the end which acts in a similar manner on a second lever, at the extremity of which is a small mirror. A lamp and vertical scale being placed at a distance of 470 cm., the slightest motion of the mirror could be read with great accuracy, an elongation of the bar amounting to $\frac{1}{1000000}$th mm. being easily detected. A few of the more important results are as follows:—In the case of soft iron the bar continually increased in length till really saturated, up to which point Mr. Joule had traced it, but then it reached a maximum, decreased, and continued decreasing to the limit of the experiments, at which point the retraction was about double of what the extension had been. The effect depended upon the thickness of the bar, an increase of diameter diminishing the maximum extension and increasing the critical magnetising force, or that force which produced the maximum extension; the results seemed to show that this extension varied inversely as the square root of the diameter of the bar. The general behaviour of steel was the same as that of soft iron, but the critical point varied with the hardness and temper of the metal, appearing to be a minimum for steel of yellow temper. The results of experiments upon nickel coincided with those obtained by Prof. Barrett, the effect of magnetisation being to cause a continuous retraction greater than that obtained with soft iron.

In answer to Prof. HUGHES, who believed that the effect of the coil was always to produce *retraction* of the bar, the *extension* at first being due to the molecular arrangement of the particles during magnetisation,

Mr. BIDWELL further described an experiment showing that the action of the coil was to produce the *extension* of a magnet. Two thin strips of soft iron were fastened together at the ends, their central portions being about two cm. apart, were placed in the coil. On making the current the ends were drawn out, the sides coming together.

Prof. FORBES suggested that the effect of thickness was really owing to the irregularity of magnetisation produced by the ends, and that in future experiments the middle of the bar only should be examined.

"On the spectral image produced by a slowly rotating vacuum-tube," by Mr. SHELFORD BIDWELL.

"Note on the action of light in diminishing the resistance of selenium," by Mr. SHELFORD BIDWELL. As the result of this investigation upon the behaviour of selenium, Messrs. Adams and Day arrived at the conclusion that it conducted electrolytically. Since this would necessitate the assumption that selenium is not an element according to accepted theories, caution must be exercised in accepting this. It seemed possible, however, that since the selenium in the cells had always undergone a prolonged cooking in contact with the metal terminals, selenides of these metals might exist in the selenium forming a kind of network, and thus affording conduction through the mass, which, without the cooking is non-conducting. It had not been possible to test this directly, but a somewhat analogous case had been tried. Some precipitated silver had been heated for some hours with sulphur, and the clear liquid poured off. A cell was then made by coiling two silver wires side by side upon a strip of mica, the spaces between them being filled with the prepared sulphur, which would contain a small quantity of sulphide of silver. It was found necessary to reduce the resistance of the cell by placing a small strip of silver leaf over the sulphur and cook again. The cell thus prepared was very sensitive to light; by burning a piece of magnesium near the resistance was reduced to one-third.

Mr. CLARK said that Mr. Bidwell's cells probably contained sulphides of copper or silver, substances which the researches of Faraday had shown conducted electrolytically in the solid condition. On the other hand, Cu_2 Se and Ag_2 Se, conducted like metals and were probably often present in the ordinary selenium light cells. Mr. Clark thought that Mr. Bidwell's paper raised this question—What influence had light upon the electrolytic conduction of Cu_2S and Ag_2S, and upon the metallic conduction of Cu_2 Se and Ag_2 Se?

"On certain cases of electrolytic decompositisn," by Mr. J. W. CLARK. The first part of this paper consisted of a critical examination of the behaviour of those substances which have been described as exceptions to Faraday's laws, with the object of generalising as to the condition of internal or molecular structure corresponding to their electrical properties. The second part described an experimental investigation into the nature of the conduction of fused mercuric iodide and mercuric chloride, both of which were stated to undergo electrolytic conduction. Decomposition and recombination of the products of electrolytic action may, however, follow so closely as to simulate metallic conduction. The first product of electrolytic decomposition of mercuric iodide was stated to be iodine and mercuroso-mercuric-iodide (Hg_4 I_6), which latter, under the continued action of the current, yields free mercury. Similarly it was found that fused mercuric chloride when electrolysed between graphite terminals split up into chlorine and mercurous chloride. Metallic conduction, *i.e.*, conduction without decomposition, in fused compound solids, therefore, appears to be unknown.

"Note on electrical symbols," by Mr. J. MUNRO.

NEW PATENTS—1885.

6187. "Electric targets." G. F. REDFERN. (Communicated by F. Gladel.) Dated May 20.

6195. "Apparatus for controlling electric currents." O. E. WOODHOUSE, F. L. RAWSON, J. H. DAVIES, Sir D. SALOMONS. Dated May 20.

6196. "Slow speed electro-motor." J. H. ADAMS. Dated May 20.

6206. "Telephone transmitters." A. M. CLARK. (Communicated by Long Distance Telephone Company.) Dated May 20. (*Complete.*)

6229. "Recording signals on siphon recorders in damp climates without the aid of statical electricity." J. H. CARSON. (Communicated by W. Dickenson.) Dated May 21.

6240. "Electric meters." F. W. CORDEN. Dated May 21.

6286. "Telescopic swinging and rotating pendant and switch for one or more incandescent electric lamps." A. GRUNDY, G. W. READY. Dated May 22.

6305. "Electric guns." J. C. MEWBURN. (Communicated by American Electric Arms and Ammunition Company.) Dated May 22.

6313. "Apparatus for lighting gas by electricity and for other purposes." C. L. CLARKE, H. J. COATES. Dated May 23.

6325. "Dynamo-electric machines." T. PARKER. Dated May 23.

6365. "Telegraphic apparatus." R. K. BOYLE. Dated May 23.

6371. "Electric arc lamps." P. JENSEN. (Communicated by V. V. Golitzinsky and P. O. Rymascheffsky.) Dated May 23.

6392. "Dynamo-electric machines." G. C. FRICKER. Dated May 26.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

7534. "Improvements in incandescent electric lamps, and in glasses therefor." G. HOOKHAM. Dated May 10. 6d. Consists of a lamp glass which slides over the lamp, and has either convex ribs or concave grooves on one or both sides of the glass (but not convex on one side and concave on the other), such grooves or ribs running parallel to the long and narrow filament.

7720. "Improvements in telephone receivers." W. R. LAKE. (Communicated from abroad by J. A. Kingsbury, of America.) Dated May 14. Relates to telephone receivers, and differs from ordinary instruments of this class in that the coil has no core, but has a hollow centre, and is fitted to lie in a non-conducting case. One face of the coil is substantially level with the face of the case, so that the diaphragm lying on the face of the case may have a proper vibration. Over this diaphragm, and bearing on its margin, is placed the sound-wave concentrator. Two binding posts are connected with the case; and with the posts are connected the wires leading respectively from the periphery and the centre of the coil. The line and battery wires are also attached to these posts. Fig. 1 is a central sectional elevation of apparatus embodying the invention. Fig. 2 is a face view of the case and coil, the other parts being removed to give a clearer view of the

FIG. 1.

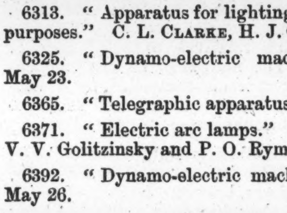
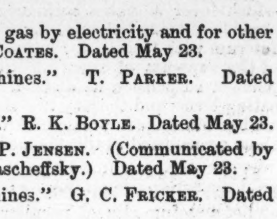


FIG. 2.



construction. A represents the non-conducting case in which is provided a chamber, B, of suitable dimensions to receive one or more coils of wire, F, formed with a hollow centre, *a*. The coils are made of insulated or covered copper wire, or insulated or covered iron wire, or they may be made in part of insulated or covered copper wire, and insulated or covered iron wire to form a single coil, or these two kinds of wire may be coiled separately to form sections of the same roll or coil, and be connected by the same switches which are employed to connect the two coils lying one above the other. The periphery of the coil is enclosed in hard India rubber, or some suitable material to hold it in position in the case. Secured to the face, C, of the case, A, and bearing on the margin of the diaphragm, D, is the sound-wave-concentrator, E, of ordinary construction. Attached to the periphery of the case, A, is a binding post, G, with which the wire, *g*, leading from the centre of the coil is connected. H is also a binding post to which a wire, *h*, leading from the periphery of the coil is connected, the wire, *g*, being connected with the battery wire, and the wire, *h*, with the transmitter by means of said posts.

7805. "Improvements in machines for generating or utilising electrical energy." G. G. M. Hardingham. (Communicated from abroad by C. Mortimer-Sterling, of Paris.) Dated May 16. 6d. It has for its object the construction of a machine in which the induction coils or fixed induced magnet, and the revolving inducing magnets or inductor are arranged concentrically, and are by preference circular in form, and in which the inducing magnets revolve within the fixed induction coils.

8018. "A new electrically operated valve for flushing cisterns and for other similar purposes." M. Syer. Dated May 21. 6d. The valve proper is connected by a short spindle to the underside of a diaphragm of India rubber or equivalent material. This short spindle passes through the diaphragm, and carries at its end an armature. At a suitable distance above the armature is fixed an electro-magnet. Both magnet and armature are enclosed, preferably in an impervious case or dome, to the lower edge of which is cemented or screwed the rubber diaphragm. The valve is opened by sending a current through the magnet.

8063. "Improvements in regulating apparatus for electric arc lamps." R. E. B. Crompton and T. Crabb. Dated May 22. 6d. Consists of a compensating lever and connecting parts for effecting the control of the movements of the carbon electrodes, and which lever actuates both carbons in its movements, it being capable of being balanced by one electrode on each side of its fulcrum with facility for adjustment of the respective distances of the supports of those electrodes relatively to the fulcrum, or point of suspension as desired. The movement of this compensating lever, and thereby the electrodes, is controlled by a solenoid or other electro-magnetic device, such as are well known to those accustomed to this class of mechanism.

8143. "An improved switch for electric light circuits." H. Faraday. Dated May 23. 6d. Consists essentially of a lever, and of a spring clip of peculiar form, between the jaws of which the end of the lever is pressed to close the circuit, the said lever being combined with a spring so applied as to tend to force the lever either towards or away from the spring clip according as it is thrown over in the one or other direction.

8241. "Improvements in telephones." M. Kotyra. Dated May 26. 6d. The inventor provides a suitable box or case, which is preferably furnished with a handle and a mouth-piece, and which has at one end a disc or diaphragm of paper, parchment, metal, or other suitable material, not necessarily magnetic. A magnet consisting of a flat bar curved or bent into the form of an arc, or segment of a circle, is fixed rigidly to the said box or case by a screw or other suitable means at a point equidistant from its ends, so that the said ends can be vibrated by the variations or fluctuations of the electric current as hereinafter described. It may be either a permanent magnet or an electro-magnet. To the ends of this magnet are fixed polar extensions, one on each side of the said magnet. These extensions project radially inward, and small coils are attached thereto as follows, that is to say:—One of these polar extensions is adjustably connected by a screw and nuts or other suitable means, to the aforesaid disc or diaphragm. The core within one of the said coils is firmly secured to this polar extension. The core within the other coil is made in two parts, one of which is fixed to the other polar extension. The other part of the said core is adjustable to and from the first-named core, so that the distance between the said cores can be regulated with great accuracy.

8460. "Improvements relating to mechanism for transporting goods and passengers by the aid of electricity." F. Jenkin and A. C. Elliott. Dated May 30. 8d. This invention is an improvement on the system of telpherage described in Patent No. 1830 of 1882. It has for its direct object an improved method of supplying to vehicles or trains of vehicles propelled by the agency of electricity the necessary electrical energy, and for the purpose of automatically regulating the traffic under certain conditions withholding that supply from any train.

8524. "Telephonic transmitting instruments or valve telephones." S. P. Thompson and P. Jolin. Dated June 3. 6d. Relates to the apparatus described in the number of the Review for April 25th.

8528. "Improvements in insulators for electric wires." E. L. Sheldon. Dated June 3. Consists of an insulator that, whilst dispensing with binding wires, has in small compass capacity for firmly gripping the wire and thereby preventing its slipping axially, which can be attached to any cross arm or ridge piece or other support usually employed, and which may be of glass, earthenware, stoneware, wood, vulcanised fibre, insulite or any other rigid or semi-rigid non-conducting or badly conducting substance, or of conducting substance properly coated with a non-conductor. The inventor specially arranges in the top or side of such insulator a curved slot or recess of such dimensions and curvature as are most suitable to the gripping of the wire of the size or stiffness employed. Figs. 1 and 2 show one form of the insulator. The pin is set with cement solidly into the socket, B, of the insulator. In order not to put too much strain on the sides of the recess the inventor arranges a shoulder, C, cast in the pin, and the pin and insulator are allowed to be free to turn in the arm by the intervention of the washers, D, D, the nut, E, being not too tightly jammed.

FIG. 1.

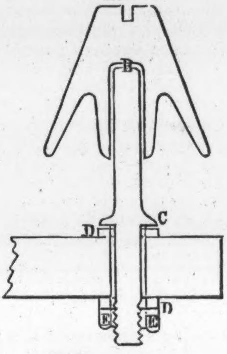
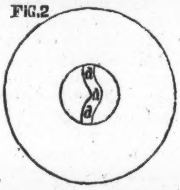


FIG. 2



8539. "Improvements in telephones." J. T. Lister. Dated June 3. 6d. Consists of a tube made of vulcanised rubber, and moulded in a single piece. It is conical in its general longitudinal form, with both ends open, one end being the mouth-piece for the speaker, and the other end being adapted to be applied closely to the face of a transmitter.

8704. "Improvements in or applicable to microphones." A. J. Boult. (Communicated from abroad by K. S. Dembinski, of Belgium.) Dated June 7. 2d. This invention is chiefly designed for use in microphones of the class described in an application for letters patent by K. S. Dembinski, No. 7312 of 1884. The "carbons" employed in practising the above-mentioned invention may, according to the present improvements, be rods or pencils of preferably pure plumbago pressed or otherwise formed into suitable shape, or they may consist of a mixture of plumbago and Indian ink finely ground, mixed and formed into suitable rods or pencils. Instead of making the "carbons" of the same substance throughout they may have a core or centre of platinum, wood, or similar material covered with the plumbago, caused to adhere thereto by glue or other suitable adhesive; in some cases the core or centre is made of brass covered with the platinum and gold; a mixture of platinum and plumbago may also be used.

8732. "Telephonic transmitting apparatus or nest telephones." S. P. Thompson. Dated June 9. 6d. Relates to the apparatus described in the number of the Review for May 2nd, 1885.

8751. "An improved telpher locomotive." F. Jenkin. Dated June 9. 8d. The object of this invention is to produce a cheap form of locomotive in which the useful adhesion shall be large and the useless friction small. The inventor obtains sufficient adhesion for most cases met with in practice by coupling two driving wheels which adhere to the rail by the friction due to the weight of the locomotive which they carry and by employing for their tyres a material having a higher coefficient of friction than that of metal on metal. He effects the coupling by a special connection which, when this is necessary, leaves the coupled wheels as free to follow curves as the wheels of the trucks described in a provisional specification.

8779. "Improvements in apparatus for working electric bells." J. H. Johnson. (Communicated from abroad by P. G. Skrivanow, of Paris.) Dated June 10. 6d. In an apparatus for working electric bells, according to this invention, one or more batteries preferably constructed as described in the specifications to Letters Patent No. 489, dated January 31st, 1882, and No. 4,460, dated September 19th, 1882, are arranged behind or under the bell, being contained or imbedded in the thickness of the board or support to which the bell is attached. These batteries supply electricity to a single coil or bobbin, constituting an electro magnet and provided with a spring armature connected to a hammer acting on the bell. This armature oscillates or vibrates in proximity to a contact connected to the battery, and consisting of an adjustable screw, the extremity of which is placed opposite a spring attached to the armature. The circuit is open when the spring on the armature is out of contact with the screw, and is closed when the spring touches the screw. The interruptions thus produced in the current cause the hammer to vibrate and ring the bell. The adjustment of the screw or contact maker of the interrupter is effected from the back of the board or support.

8865. "Improvements in mechanism for regulating electric arc lamps." T. Cuttriss. Dated June 12. 6d. The top carbon is fixed to a rack which is free to move up or down through supports at the top and bottom of the lamp, into the rack is geared a pinion, which is supported on a lever at a suitable distance from its fulcrum so that when the lever is raised or lowered the pinion describes an arc, and in doing so raises or lowers the rack accordingly, the pinion at the same time being kept from revolving until the proper time by suitable mechanism. Fixed to the pinion is a ratchet wheel for the purpose of allowing the rack to be raised to permit of the replacing of the carbons without bringing the remaining mechanism into play, upon allowing the rack to descend a catch engages with the ratchet wheel, and causes the descent of the carbon to be controlled by means of mechanism.

8901. "Improvements in current-regulating devices for use in the circuits of electric lamps or other apparatus." S. F. Walker and F. G. Olliver. Dated June 12. 6d. The present invention is designed to further provide for the regulation of electric currents by means of apparatus somewhat similar to that described in the specification of former Letters Patent, dated March 29th, A.D. 1884, No. 5,690, but differing therefrom in respect of the principle of its regulating action.

8908. "A primary voltaic battery." E. Tyer. Dated June 12. 6d. The battery consists of a number of compartments, each in the form of a rectangular vessel of insulating material, these compartments being superposed in a framing in which each compartment is arranged like a drawer in a chest of drawers, so that it can be drawn forward to give access to it when required.

9099. "Improvements in and relating to the manufacture of electrical wires or conductors." H. H. Lake. (Communicated from abroad by J. J. Williamson, of America.) Dated June 17. 8d. Relates to electrical wires or conductors made of two or more metals, one at least of which is used for providing the conductor with sufficient tensile strength and other material qualities, and which shall possess great conductivity.

9265. "An electromotor." R. B. Gant. Dated June 21. 6d. An armature or motor formed in the shape of a drum, or short cylinder, has on its periphery a number of bar electro-magnets which act and re-act by attraction and repulsion on field-magnets, causing rapid revolution on its axis. By the construction of the motor, and the peculiar arrangement of the magnets, the principles of leverage, momentum and induction are combined in an advantageous manner, so as to produce the greatest amount of power, with a comparatively small expenditure of electric energy.

CORRESPONDENCE.

A New Battery for Bell-ringing, &c.

The Leclanché Battery, though an exceptionally good one for bell-ringing and kindred purposes, has several admitted defects, viz., the internal resistance is excessive; crystals (of chloride of zinc) soon form on the zinc rod, and stop the working of the battery; the chloride of ammonium salt "creeps" up the porous pot and over the outer jar, impoverishing the liquid and corroding the connections. The cost of the liquid is, relatively, considerable.

With a view to these drawbacks, I have devised a cell which appears to avoid them all.

The negative element and depolariser of my cell is a modification of Leclanché's, and consists of a cylindrical carbon rod, surrounded by a mixture of broken gas retort carbon and powdered peroxide of manganese, enclosed in a very soft red-ware porous pot, 6 in. × 2 in., and sealed with a compound of rosin and pitch. The positive electrode is a plate of *amalgamated* zinc, 6 in. × 2 in. × $\frac{1}{4}$ in. The liquid consists of one part sulphuric acid (by weight) to thirty-two parts water.

The E.M.F. of this cell is 1·8 volt, and the internal resistance about 1 ohm.

The E.M.F. of the Leclanché cell is 1·5 volt, and the internal resistance 5 to 6 ohms (for the medium size).

I have not had these cells in use long enough to test their durability, but one of them has been attached to a bell circuit (which requires three Leclanchés to operate it) for over two months, and does not show signs of deterioration in any way; indeed, there is no reason why the liquid should not last until it becomes saturated with zinc zulphate, which would be a long time.

G. H. Bays, jun.

Taylor's Telephone.—"Flashing" Patents.

I am interested by your description of Mr. Taylor's telephone, on page 462 of this week's issue, and agree with you as to his setting an exaggerated value on its practicability. I made a telephone on this principle in November, 1879, but was unable to do much in experimenting with it till the early part of 1881, when I carried out a tolerably long series of experiments on different forms of the instrument. On October 30th, 1882, I took out a patent for my invention, which was numbered 5,164, and of which I send you herewith copy of specification. With this patent I did not proceed beyond provisional protection, as the results, though fairly good, were not such as would have rendered competition with the existing instruments possible.

As I am writing you, I may as well reply to the letter of "Looker On," in your issue of 9th inst., by saying that my Patent No. 2,848, of 1881, is not in the same hands as the Sawyer-Mann patent, and I have no knowledge of any attempts being made to establish any such monopoly as he refers to.

J. G. Lorrain.

3, Vernon Chambers, Southampton
Row, W.C., 27*th May*, 1885.

[Mr. Lorrain's specification describes precisely similar arrangements to those of Mr. Taylor as illustrated in our last issue.—Eds. Elec. Rev.]

New Electrical Experiments.

While experimenting with vacuum tubes on the 23rd curt., I observed a phenomenon which I have seen no published account of. The source of electricity used was a coil machine, the primary coil being excited by a battery. Having by the means of a small insulated gas flame determined the direction in which the current of electricity was passing between the terminals of the secondary coil, I applied the plus or electricity-giving terminal of the coil to the right arm of a V-shaped vacuum tube, and the minus or exit-terminal of the current I attached to the left hand terminal of the V tube. As seen in the dark, the right hand arm of the tube was full of pink-coloured rays of light, extending from the platinum terminal at the top of the arm down to nearly the bottom, but not to the very bottom of that half of the tube; the pink rays of light stopped at a horizontal line parallel with the upper edge of the bent part of the tube. The left arm of the tube was filled with a greenish-yellow light, which extended round the turn at the bottom of the tube until it met the horizontal line of pink light in the right arm of the tube. The greenish-yellow light filled all the left arm of the tube except a small inverted pyramid of pink light, which was attached to the under side of the platinum disc which forms the inner end of the terminal of the tube. This small inverted pyramid of pink light was evidently kept in existence by particles of the pink light coming from the right arm of the tube; but these particles of pink light were invisible as they passed up through the greenish-yellow light in the left arm of the tube; it was only on their arriving close to the platinum disc that they became visible as they rushed against it. This state of matters led me to think that a change would take place if I inverted the tube, and used it like a letter A instead of a V. Having inverted the tube, I passed the electricity through it in the same direction as before. The right arm of the tube was again filled with rays of pink light, which now turned the corner of the tube and descended into the left arm, filling it also with the pink light. From this it was manifest that either the magnetism of the earth or the attraction of gravitation had been the cause why the pink light did not freely ascend into the left arm of the tube when it was used like a letter V. To determine this question I made the following experiment with a straight vacuum tube, 13½ inches in length between the inside terminals, and ¾ of an inch in diameter, and having at one end of it a small chamber for holding potash, so that when the latter is heated the vacuum may be partially destroyed. When this tube has been undisturbed for some days and then electricity passed through it, throughout the length of it there is nothing visible but the greenish-yellow light, similar to that which is seen in the V tube. But after the potash has been heated the tube is filled with striæ of pink light. When about to make the following experiment I first tested the straight tube with electricity while it lay in a horizontal position, and found that it had not had time to fall back into the state of greenish-yellow light since the time I had previously heated the potash; there were still in the tube striæ of pink light, which extended from the end by which the electricity was admitted to the tube to within 3½ inches of the outlet terminal. I now placed the tube in a perpendicular position and admitted the electricity to it, so that the current went in by the bottom terminal and went out at the top one. While thus arranged, the pink light extended from the bottom terminal to within 3½ inches of the top of the tube. These 3½ inches were filled with greenish-yellow light, and this part of the tube was quite transparent. The pink striæ in the lower part of the tube were well defined, being much flattened spheres, and the highest of these striæ was so flat on the top that there was a well-defined line between it and the greenish-yellow light above. I now reversed the current of electricity, making it to descend through the tube. Immediately the whole appearance was changed. The great mass of the pink light was now at the top of the tube, and the 3½ inches of greenish-yellow light at the bottom of it, with this very marked difference, that the pink striæ were no longer well defined; they seemed to run into one another, and there was no defined line between the pink striæ and the 3½ inches of the greenish-yellow light at the bottom of the tube, and the latter was no longer transparent, the pink particles were seen descending through the greenish-yellow light. From these facts it is manifest that gravitation must be the force operating on the pink particles of potash, which, as far as known, are not acted upon by the earth's magnetism.

These experiments prove that the plus or inlet terminal of the current of electricity exerts the greatest amount of force in controlling the potash matter. Now this is opposed to the statement of Mr. Crookes that the minus or negative terminal of these tubes exercises the most influence over the matter within them.

The tubes I have were made by the same party who made tubes for Mr. Crookes.

James Johnstone.

8, Dalhousie Terrace, Edinburgh,
May 5*th*, 1885.

The Bürgin Armature.

I purpose constructing a dynamo with a Bürgin armature, but am somewhat in doubt as to mode of connecting up. If you or any reader would give me a description of the connections (with diagram if you could spare the space) it would be conferring a great boon on

Armature.

The "New" Telephone.

I had not intended to trouble you further as regards this instrument, but having read Mr. J. W. Barnard's letter in your issue of May 23rd, I feel it incumbent on myself to point out that the criticisms contained in my former letter are not altogether so mistaken as Mr. Barnard appears to imagine.

The membrane receiver consists essentially of two parts.

(1.) The membrane diaphragm.

(2.) The electro-magnet with concentric poles.

Professor Thompson thus describes his diaphragm:—"We unite together two membranes after placing between them an armature of clock-spring or of iron, and we also in some cases enclose between them a frame . . . to support the membranes and stretch them." The specification goes on to describe suitable cement for uniting the membranes and materials for waterproofing the same.

If we now turn to Eldred's specification, No. 676, 1883 (not 1882, as mentioned by Mr. Barnard), we find a very similar arrangement described and claimed.

We have once more the two membranes with the armature and carrier frame placed between them, and also a waterproofing material.

Professor Thompson's membrane is very probably an improvement on Eldred's, but it is merely an improvement. Both are modifications of the original Bell membrane, but Eldred has undoubtedly priority for his improvements, which substantially cover those of Professor Thompson.

I understand that Eldred's patent, which at one time was the property of the London and Globe Telephone Company, has now passed into the hands of the United Telephone Company, who will doubtless bring it to bear upon the New Telephone Company and those who employ their instruments.

Now to turn to the second part of the new membrane receiver, *i.e.*, the electro-magnet with concentric poles, I would point out to Mr. Barnard that whether or not the magnet is made to form the handle of the instrument is not the matter in question. The point of importance is the employment of concentric poles, which have been for some years employed in the D'Arsonval Telephone, which was, I believe, the first so constructed, as Phelp's "pony-crown" instrument has no arrangement of the kind.

I do not imagine that Professor Thompson can maintain a claim for his magnet merely because it is an electro-magnet while D'Arsonval's is permanent, for the employment of electro-magnets is not new, and the transforming of the D'Arsonval permanent magnet into a D'Arsonval electro-magnet does not appear to constitute matter for a valid patent.

Reviewing the instrument as a whole, my humble opinion remains this: The instrument consists of two essential parts, the membrane and the magnet. The former cannot be manufactured or sold without infringing Eldred's patent, which is the property of the United Telephone Company. The latter is not novel, and can therefore be made by any one.

I now come to the last part of Mr. Barnard's letter. I am quite aware that Professor Thompson's "plug" arrangement is designed with a view to permit of the receiver magnet being magnetised by a local battery, which may consist of less cells than would be necessary if the current passed through the entire line wire. This, however, does not alter the fact that with Professor Thompson's telephone arrangement a very much larger number of cells is required than with the usual system of transmitters and receivers with permanent magnets.

From experience of my own I opine that even on short lines the "new" arrangement will require at least *three* cells at each end of the line, while the ordinary Bell-Blake instruments only take *one*. This is a very serious consideration, and where magneto-bells are employed will add largely to the cost of maintenance of the instruments.

There are other points—such as the increased resistance of the circuit consequent on the employment of so many cells, which will tell unfavourably against Professor Thompson's arrangement; but as I fear I am encroaching too much on your valuable space, and as, moreover, comparisons between the efficiency of the two systems are probably unacceptable to Mr. Barnard, I must draw this epistle to a close.

"Telephonist."

May 23*rd*, 1885.

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